^{253}Es α decay (20.47 d) 2005Ah03,1975Ah01

History			
Type	Author	Citation	Literature Cutoff Date
Full Evaluation	C. D. Nesaraja	NDS 195,718 (2024)	12-Oct-2023

Parent: ^{253}Es: E=0.0; $J^\pi=7/2^+$; $T_{1/2}$=20.47 d *3*; Q(α)=6739.24 *5*; %α decay=100

^{253}Es-J^π,$T_{1/2}$: From Adopted Levels of ^{253}Cf (2013Br09).

^{253}Es-Q(α): From 2021Wa16.

2005Ah03: ^{253}Es was produced by milking ^{253}Cf that was produced in the High Flux Isotope Reactor at the Oak Ridge National Laboratory at three different irradiations done in 1998, 2000 and 2003. The sample produced in the 2003 irradiation was chemically and isotopically pure and provided the most sensitive measurements. Eγ, %Iγ, $\alpha\gamma$ coin for all the three samples were measured. Single low energy gammas (<600 keV) were measured using two different LEPS detectors while a 25% Ge detector was used to measure the high energy gammas. $\alpha\gamma$ coincidence measurements were peformed with a Si detector for the aphas and a 110% Ge detector for the gammas. Measurements were performed separately with the 2003 sample at Argonne National Laboratory using the Gammasphere array of 99 Compton-suppressed Ge detectors. $\gamma\gamma$ coincidence measurements were measured at Lawrence Livermore National Laboratory using two Ge(Li) detectors. Absolute γ-ray intensities were determined by measuring the alphas from the decay of ^{253}Es with a Si detector of known solid angle and gammas with a Ge spectrometer whose efficiency was determined with a calibrated source.

1975Ah01: ^{253}Es was produced in the β- decay of ^{253}Cf at Oak Ridge National Laboratory and was chemically purified. α particles were measured with an array of 14 surface barrier detectors at the Argonne double focusing magnetic spectrometer. Measured Eα and Iα. Deduced levels and hindrance factors.

1972Bb24 (also 1971Ba49): Alpha decay was studied using the technique of deviation of charged particles in a magnetic field using the magnetic α-spectrograph. Measured α spectrum, Eα, Iα.

1971HoZQ: ^{253}Es was obtained from the milking of ^{253}Cf at the Oak Ridge National Laboratory. The gamma spectrum from the decay was measured with a Ge(Li) detector. Measured Eγ, Iγ and K-conversion coefficients.

1965Ho15: The internal-conversion electron spectrum was measured with the Berkeley 50-cm iron-free spectrometer. Half-lives were determined from indirect measurements of the distance the recoil travelled before emitting conversion electrons using the electrostatic pre-accelerator system in with the iron-free spectrometer.

1964Ho10: ^{253}Es was produced by heavy-isotope production from neutron irradiations on appropriare target materials such as ^{244}Cm. The internal conversion electron spectrum was examined with the iron-free spectrometer. Measured Eγ, Iγ and conversion electron subshell ratios.

1963Le17: Alpha decay of ^{253}Es was studied using the NaI scintillator for the gammas. In addition, an anthracene scintillator electron detector and an alpha detector consisting of a phosphorus-diffused p-n silicon detector were used in the alpha-electron coincidences measurements.

1960As06, 1960As08: Alpha and electron spectra of ^{253}Es were investigated with high-resolution magnetic spectrographs. Measured $\alpha\gamma$ coin., α-e.

Others:

1990Po14: Measured relative L and M x-ray intensities from the decay using the x-ray spectrometer.

All data are from 2005Ah03, unless otherwise stated.

^{249}Bk Levels

E(level)†	J^π‡	$T_{1/2}$	Comments
0.0#	$7/2^+$	327.2 d *3*	$T_{1/2}$: From Adopted Levels.
8.771@ *14*	$3/2^-$	0.3 ms	$T_{1/2}$: From (α)(ce)-delayed coincidence measurement (1960As08,1960As06). No uncertainty was provided.
39.614@ *13*	$5/2^-$		
41.805# *7*	$9/2^+$	9 ps *2*	$T_{1/2}$: From indirect measurement of the distance the recoil travelled before emitting conversion electrons (1965Ho15).
82.595@ *12*	$7/2^-$		
93.759# *8*	$11/2^+$	5 ps *1*	$T_{1/2}$: From indirect measurement of the distance the recoil travelled before emitting

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^{253}Es α decay (20.47 d) 2005Ah03,1975Ah01 (continued)

^{249}Bk Levels (continued)

E(level)†	Jπ‡	Comments
		conversion electrons (1965Ho15).
137.711@ 12	9/2−	
155.854# 9	13/2+	
204.572@ 13	(11/2−)	
229.242# 11	(15/2+)	
283.131@ 14	(13/2−)	
311.857# 22	(17/2+)	
373.179@ 24	(15/2−)	
377.552f 24	(1/2+)	
389.170& 17	(5/2+)	
410.71f 10	(3/2+)	
421.376f 24	(5/2+)	
428.955& 13	(7/2+)	
473.66@ 21	(17/2−)	
475.002& 14	(9/2+)	
498.68f 7	(7/2+)	
519.189f 20	(9/2+)	
542.095& 19	(11/2+)	
558.179g 26	(3/2−)	
569.21g 5	(1/2−)	
597.835& 16	(13/2+)	
606.691g 29	(7/2−)	
624.30i 17	(5/2+)	
624.93g 4	(5/2−)	
642.74h 18	(1/2−)	
654.1 5		E(level): Possible 11/2+ member of 1/2[400] band; 2005Ah03 calculated 639 keV for expected 11/2+ member from rotational constant and decoupling parameter quoted above for the band. 135 γ seen in coin with 425 transition from 9/2+ member.
661.35h 12	(3/2−)	
671.089f 22	(13/2+)	
672.81d 9	(5/2−)	
701.85& 15	(15/2+)	
703.42i 10	(7/2+)	
704.84g 4	(11/2−)	
709.15h 11	(5/2−)	
711.15d 12	(7/2−)	
723.17g 7	(9/2−)	
767.89b 9	(9/2−)	
769.15i 14	(9/2+)	
836.07b 13	(11/2−)	
899.63e 13	(3/2−)	
911.16b 21	(13/2−)	
932.19c 5	(7/2−)	
934.64e 17	(5/2−)	
988.14?c 9	(9/2−)	
1055.82?c 7	(11/2−)	

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^{253}Es α decay (20.47 d) 2005Ah03,1975Ah01 (continued)

^{249}Bk Levels (continued)

E(level)†	Jπ‡	Comments
1075.05[a] 8	9/2+	
1133.91?[c] 8	(13/2−)	
1143.78[a] 14	11/2+	
1150.64 12	(5/2−)	Possible configuration=7/2[633]⊗1−5/2−.
1223.01 10	(7/2+)	Configuration=7/2[633]⊗0−7/2+.
1227.54?[c] 10	(15/2−)	

† From least-squares fit to Eγ data by the evaluator, unless stated otherwise.
‡ From Adopted Levels. The assignments to levels >700 keV are by 2005Ah03 from deexcitation patterns of the levels to members of lower rotational bands, and α-decay hindrance factors or available configurations as provided in the Adopted Levels.
# Band(A): 7/2[633].
@ Band(B): 3/2[521].
& Band(C): 5/2[642].
a Band(D): 9/2[624].
b Band(E): 7/2[633]⊗1−9/2− vibrational band.
c Band(F): 7/2[633]⊗0−7/2− vibrational band.
d Band(G): 7/2[633]⊗1−5/2− vibrational band.
e Band(H): 7/2[633]⊗2−3/2− vibrational band.
f Seq.(K): 1/2[400].
g Seq.(L): 1/2[530]. Value of rotational constant ($\hbar^2/2J$=4.840 keV) from 2005Ah03 indicates Coriolis mixing of 1/2[530], $K^\pi=1/2^-$, and other negative parity bands present.
h Band(I): $K^\pi=1/2^-$. Value of rotational constant ($\hbar^2/2J$=7.84 keV) from 2005Ah03 indicates Coriolis mixing of 1/2[530], $K^\pi=1/2^-$, and other negative parity bands present.
i Band(J): Possible 3/2[651] band.

α radiations

Eα‡	E(level)	Iα‡[a]	HF†	Comments
5425@ 1	1227.54?	9.0×10−7& 9	70 7	Iα: 9.0×10−7 (2005Ah03). Eα: 5424 (2005Ah03).
5429@ 1	1223.01	8.8×10−6& 6	7.6 6	Iα: 7.8×10−6 (2005Ah03). Eα: 5429 (2005Ah03).
5500@ 1	1150.64	5.4×10−6& 4	34 3	Iα: 5.4×10−6 (2005Ah03). Eα: 5500 (2005Ah03).
5507@ 1	1143.78	1.82×10−6& 21	111 13	Iα: 1.8×10−6 (2005Ah03). Eα: 5507 (2005Ah03).
5517@ 1	1133.91?	3.00×10−6& 20	77 6	Iα: 3.0×10−6 (2005Ah03). Eα: 5517 (2005Ah03).
5575@ 9	1075.05	5.9×10−6& 4	87 6	Iα: 6.9×10−6 (2005Ah03). Eα: 5575 (2005Ah03).
5594@ 8	1055.82?	7.6×10−6& 5	87 6	Iα: 7.4×10−6 (2005Ah03). Eα: 5594 (2005Ah03).
5660@ 1	988.14?	1.30×10−5& 7	125 7	Iα: 1.3×10−5 (2005Ah03). Eα: 5661 (2005Ah03).
5713@ 1	934.64	≈3.9×10−6&	≈841	Iα: ≈6×10−6 (2005Ah03). Eα: 5713 (2005Ah03).
5715@ 1	932.19	5.7×10−5& 12	59 13	Iα: 6.7×10−5 (2005Ah03). Eα: 5716 (2005Ah03).

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^{253}Es α decay (20.47 d) 2005Ah03,1975Ah01 (continued)

α radiations (continued)

Eα[‡]	E(level)	Iα[‡a]	HF[†]	Comments
5736[@] *1*	911.16	6.2×10^{-6}[&] *5*	717 *58*	Iα: ≈6×10^{-6} (2005Ah03). Eα: 5736 (2005Ah03).
5747[@] *1*	899.63	2.3×10^{-5}[&] *12*	2.2×10^{2} *12*	Iα: ≈3×10^{-5} (2005Ah03). Eα: 5747 (2005Ah03).
5810[@] *1*	836.07	4.07×10^{-6}[&] *33*	2.85×10^{3} *23*	Iα: ≈4×10^{-6} (2005Ah03). Eα: 5810 (2005Ah03).
5876[@] *1*	769.15	≈3.5×10^{-6}[&]	≈7652	
5877[@] *1*	767.89	≈3.31×10^{-5}[&]	≈822	Iα: 3.3×10^{-5} (2005Ah03). Eα: 5877 (2005Ah03).
5921[@]	723.17	6×10^{-5}[&] *6*	7.9×10^{2} *79*	
5933[@]	711.15	≈3.6×10^{-6}[&]	≈15202	
5935 *4*	709.15	≈4×10^{-5}	≈1402	Iα: 1.23×10^{-5} *18* deduced by the evaluator from γ-intensity balance.
5944 *3*	704.84	1.5×10^{-4} *5*	3.9×10^{2} *14*	Iα: 1.1×10^{-4} *8* deduced by the evaluator from γ-intensity balance.
5940[@] *1*	703.42	≈6.6×10^{-6}[&]	≈9113	
5942[@] *1*	701.85	6.0×10^{-6}[&] *11*	1.02×10^{4} *19*	
5971[@] *1*	672.81	≈7×10^{-6}[&]	≈12466	Iα: ≈3×10^{-6} (2005Ah03). Eα: 5971 (2005Ah03).
5972[b] *1*	671.089	≈6×10^{-5}	≈1485	Iα: 5×10^{-5} *4* deduced by the evaluator from γ-intensity balance.
5982[@] *1*	661.35	5.5×10^{-6}[&] *25*	1.82×10^{4} *83*	
5989[@] *1*	654.1	<1.0×10^{-6}[&]	>109005	
6000[@] *1*	642.74	5.7×10^{-6}[&] *14*	2.20×10^{4} *54*	
6019 *3*	624.93	1.8×10^{-4} *5*	8.6×10^{2} *24*	Iα: 6.5×10^{-5} *5* deduced by the evaluator from γ-intensity balance.
6018[@] *1*	624.30	≈3.9×10^{-6}[&]	≈40112	
6037 *3*	606.691	2.9×10^{-4} *7*	6.7×10^{2} *16*	Iα: 2.0×10^{-4} *21* deduced by the evaluator from γ-intensity balance.
6046 *3*	597.835	4.0×10^{-4} *9*	5.4×10^{2} *12*	Iα: 3.8×10^{-4} *31* deduced by the evaluator from γ-intensity balance.
≈6071[b]	569.21	≤5×10^{-5}	≥6005	Iα: 4.4×10^{-5} *4* deduced by the evaluator from γ-intensity balance.
6084 *3*	558.179	2.5×10^{-4} *5*	1.37×10^{3} *29*	Iα: 1.7×10^{-4} *7* deduced by the evaluator from γ-intensity balance.
6100 *2*	542.095	0.0034 *2*	122 *7*	Iα: 0.00104 *12* deduced by the evaluator from γ-intensity balance.
6122 *2*	519.189	7.8×10^{-4} *8*	6.9×10^{2} *7*	Iα: 3.80×10^{-4} *30* deduced by the evaluator from γ-intensity balance.
6142[@] *1*	498.68	2.36×10^{-5}[&] *26*	2.91×10^{4} *33*	
6166 *2*	475.002	0.015 *1*	60 *4*	Iα: 0.0148 *6* deduced by the evaluator from γ-intensity balance.
6167[@] *1*	473.66	≈9×10^{-6}	1.0×10^{5} *7*	Iα: ≈9.0×10^{-6} deduced by the evaluator from γ-intensity balance.
6211 *2*	428.955	0.039 *2*	39.2 *21*	Iα: 0.0427 *18* deduced by the evaluator from γ-intensity balance.
6217 *3*	421.376	≈1.5×10^{-3}	1.1×10^{3} *8*	Iα: 6.3×10^{-5} *23* deduced by the evaluator from γ-intensity balance.
6230 *3*	410.71	1.2×10^{-4} *4*	1.6×10^{4} *6*	Iα: 2.0×10^{-6} *32* deduced by the evaluator from γ-intensity balance.
6250 *2*	389.170	0.045 *2*	53.3 *25*	Iα: 0.0480 *18* deduced by the evaluator from γ-intensity balance.
6261[@b] *6*	377.552	3.29×10^{-4}[&] *21*	8.3×10^{3} *6*	Eα: Not reported by 1975Ah01.
6266 *2*	373.179	8.0×10^{-4} *8*	3.6×10^{3} *4*	Iα: 1.90×10^{-4} *16* deduced by the evaluator from γ-intensity balance.
6325 *3*	311.857	4.0×10^{-4} *10*	1.4×10^{4} *4*	Iα: 4.4×10^{-5} *29* deduced by the evaluator from γ-intensity balance.
6354 *2*	283.131	0.0082 *4*	9.5×10^{2} *5*	Iα: 0.018 *10* deduced by the evaluator from γ-intensity balance.
6408 *2*	229.242	0.013 *1*	1.08×10^{3} *9*	Iα: 0.032 *20* deduced by the evaluator from γ-intensity balance.
6432 *2*	204.572	0.061 *3*	301 *15*	Iα: 0.281 *30* deduced by the evaluator from γ-intensity balance.
6480 *2*	155.854	0.085 *3*	364 *14*	Iα: 0.068 *22* deduced by the evaluator from γ-intensity balance.
6498 *2*	137.711	0.26 *1*	144 *6*	Iα: 0.03 *4* deduced by the evaluator from γ-intensity balance.
6540 *2*	93.759	0.85 *2*	70.3 *19*	Iα: 0.77 *5* deduced by the evaluator from γ-intensity balance.
6552 *2*	82.595	0.71 *2*	94.6 *29*	Iα: 0.62 *10* deduced by the evaluator from γ-intensity balance.
6590.5 *14*	41.805	6.6 *10*	15.6 *25*	Eα,Iα: From 1991Ry01.

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^{253}Es α decay (20.47 d) 2005Ah03,1975Ah01 (continued)

α radiations (continued)

Eα‡	E(level)	Iα‡a	HF†	Comments
6624# 2	8.771	0.8#	1.8×10^2	
6633	0.0	89.8 2	1.761 22	Iα: 89.9% deduced by 2005Ah03 from γ-intensity balance.

† The nuclear radius parameter $r_0(^{249}Bk)$=1.49492 *49* is deduced from interpolation of radius parameters of the adjacent even-even nuclides in 2020Si16.
‡ From 1975Ah01, unless otherwise noted. Assigned to levels in 2005Ah03 based on similar level energy and spin-parity.
# From 1972Bb24.
@ Deduced by the evaluator from level excitation energies. Energies are rounded to the nearest keV with an estimated uncertainty of 1 keV. Values deduced by 2005Ah03 from level excitation energies are given in comments.
& Deduced by the evaluator from gamma intensity balance at each level. Values deduced by 2005Ah03 from summing intensities of transitions deexciting that level are given in comments.
a Absolute intensity per 100 decays.
b Existence of this branch is questionable.

γ(^{249}Bk)

The Bk x-ray intensities (2005Ah03):

E(x ray)	I(x ray)	Bk x ray
107.17 *1*	9.3×10^{-3} *3*	$K_{\alpha 2}$
112.10 *1*	1.5×10^{-2} *1*	$K_{\alpha 1}$
125.42 *2*	1.86×10^{-3} *15*	$K_{\beta 3}$
126.57 *2*	3.61×10^{-3} *20*	$K_{\beta 1}$
127.36 *5*	1.96×10^{-4} *20*	$K_{\beta 5}$
130.24 *2*	1.47×10^{-3} *12*	$K_{\beta 2}$+$K_{\beta 4}$
131.30 *2*	4.5×10^{-4} *4*	$KO_{2,3}$

E_γ [†]	I_γ [†&]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	α[@]	Comments
(8.77)		8.771	3/2$^-$	0.0	7/2$^+$	[M2]		3.07×10^6 *4*	α(M)=2.222×10^6 *31* α(N)=6.49×10^5 *9*; α(O)=1.653×10^5 *23*; α(P)=2.97×10^4 *4*; α(Q)=1564 *22* E_γ: Deduced by the evaluator from level energy difference. $I_{(\gamma+ce)}$: I(γ+ce)(8.77γ)= 2.59 *27* deduced by evaluator from intensity balance.
30.85 *1*	5.5×10^{-3} *5*	39.614	5/2$^-$	8.771	3/2$^-$	M1+E2	0.114 *+29−18*	3.1×10^2 *4*	α(L)=231 *29*; α(M)=59 *8* α(N)=16.3 *23*; α(O)=4.1 *6*; α(P)=0.78 *9*; α(Q)=0.0441 *6* Mult.,δ: M1:M2:M3=100:32:15, N1:N2:N3=23:7:5, M/N=4.2 (1965Ho13).
41.80 *1*	5.6×10^{-2} *4*	41.805	9/2$^+$	0.0	7/2$^+$	M1+E2	0.140 *+39−23*	122 *14*	α(L)=90 *10*; α(M)=22.9 *30* α(N)=6.3 *8*; α(O)=1.61 *20*; α(P)=0.307 *32*; α(Q)=0.01781 *28* Mult.,δ: L1:L2:L3=100:28.9:12.0, M1:M2:M3:M4=23.5:7.1:3.5:0.08 L/M=4.12 (1965Ho13).
42.98 *1*	8.0×10^{-3} *8*	82.595	7/2$^-$	39.614	5/2$^-$	M1+E2	0.111 *+25−16*	103 *6*	α(L)=77 *5*; α(M)=19.3 *13* α(N)=5.3 *4*; α(O)=1.37 *9*; α(P)=0.263 *15*; α(Q)=0.01647 *24* Mult.,δ: L1:L2:L3=100:27.4: 7.1, M1:M3=25.6: 2.5, L/M=4.6 (1965Ho13).
51.96 *1*	1.38×10^{-2} *8*	93.759	11/2$^+$	41.805	9/2$^+$	M1+E2	0.143 *4*	60.0 *10*	α(L)=44.7 *7*; α(M)=11.24 *18* α(N)=3.11 *5*; α(O)=0.794 *13*; α(P)=0.1524 *24*; α(Q)=0.00935 *13* Mult.,δ: L1/L2=4.35 3, L1/L3=11.33 15, L2/L3=2.60 4 (1964No08); L1:L2:L3=100: 23.1: 9.1, M1:M2:M3=22.1: 7.1: 2.3, L/M=4.2 (1965Ho13).
55.11 *1*	5.5×10^{-3} *4*	137.711	9/2$^-$	82.595	7/2$^-$	M1+E2	0.146 *+38−32*	50 *4*	α(L)=37.2 *26*; α(M)=9.3 *7* α(N)=2.58 *21*; α(O)=0.66 *5*; α(P)=0.127 *8*; α(Q)=0.00786 *13* Mult.,δ: L1:L2:M1:M2=100: 22: 24: 6.4 (1965Ho13).

$^{249}_{97}Bk_{152}$-6

^{253}Es α decay (20.47 d) 2005Ah03,1975Ah01 (continued)

γ(^{249}Bk) (continued)

E_γ[†]	I_γ[†&]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	α[@]	Comments
55.6[‡]	<1×10^{-6}[‡]	597.835	(13/2$^+$)	542.095	(11/2$^+$)				E_γ: The transition was observed between 597.7 and 542.1. The difference in energy=55.6, while the authors in 2005Ah03 report 54.2 keV. This value does not fit with their level scheme. Therefore, the evaluator adopts 55.6 instead.
62.08 *1*	2.6×10^{-3} *2*	155.854	13/2$^+$	93.759	11/2$^+$	M1+E2	0.16 *4*	34.9 *23*	α(L)=26.0 *16*; α(M)=6.5 *5* α(N)=1.80 *13*; α(O)=0.461 *32*; α(P)=0.089 *5*; α(Q)=0.00552 *10* Mult.,δ: L2:M1:M2:M3=100: 82: 24: 7 (1965Ho13).
66.86 *1*	2.1×10^{-3} *2*	204.572	(11/2$^-$)	137.711	9/2$^-$	(E2)		135.9 *19*	α(L)=98.1 *14*; α(M)=27.8 *4* α(N)=7.79 *11*; α(O)=1.906 *27*; α(P)=0.314 *4*; α(Q)=0.000997 *14* Mult.: L1/M1=3.2 (1965Ho13).
70.0[‡]	<1×10^{-6}[‡]	498.68	(7/2$^+$)	428.955	(7/2$^+$)				
73.43 *2*	5.7×10^{-4} *5*	229.242	(15/2$^+$)	155.854	13/2$^+$	(M1,E2)		53 *34*	α(L)=38 *24*; α(M)=11 *7* α(N)=3.0 *20*; α(O)=0.7 *5*; α(P)=0.13 *8*; α(Q)=0.0021 *14* Mult.: L1/M1=4 (1965Ho13).
73.82 *1*	9.5×10^{-4} *9*	82.595	7/2$^-$	8.771	3/2$^-$	E2		84.9 *12*	α(L)=61.2 *9*; α(M)=17.38 *24* α(N)=4.86 *7*; α(O)=1.191 *17*; α(P)=0.1964 *28*; α(Q)=0.000663 *9* Mult.,δ: L2:L3:M2:M3=100:63:30:24 (1965Ho13).
78.56 *1*	4.1×10^{-4} *3*	283.131	(13/2$^-$)	204.572	(11/2$^-$)	[M1,E2]		39 *24*	α(L)=29 *17*; α(M)=8 *5* α(N)=2.2 *14*; α(O)=0.55 *34*; α(P)=0.09 *5*; α(Q)=0.0017 *12*
78.8[‡]	<1×10^{-6}[‡]	597.835	(13/2$^+$)	519.189	(9/2$^+$)				
82.61[a] *2*	5.2×10^{-5}[a] *5*	82.595	7/2$^-$	0.0	7/2$^+$				
82.61[a] *2*	5.2×10^{-5}[a] *5*	311.857	(17/2$^+$)	229.242	(15/2$^+$)				
87.5[‡] *2*	≈1×10^{-6}[‡]	606.691	(7/2$^-$)	519.189	(9/2$^+$)				
89.9[‡]	<1×10^{-6}[‡]	519.189	(9/2$^+$)	428.955	(7/2$^+$)				
90.05 *2*	3.1×10^{-5} *3*	373.179	(15/2$^-$)	283.131	(13/2$^-$)				
93.76 *1*	1.2×10^{-3} *1*	93.759	11/2$^+$	0.0	7/2$^+$	E2		27.5 *4*	α(L)=19.87 *28*; α(M)=5.64 *8* α(N)=1.579 *22*; α(O)=0.387 *5*; α(P)=0.0642 *9*; α(Q)=0.000256 *4* Mult.,δ: L2:L3:M2:M3=100: 63: 27: 21 (1965Ho13).
95.90 *2*	2.7×10^{-5} *3*	137.711	9/2$^-$	41.805	9/2$^+$	[E1]		0.1603 *22*	α(L)=0.1200 *17*; α(M)=0.0298 *4* α(N)=0.00813 *11*; α(O)=0.002005 *28*; α(P)=0.000346 *5*; α(Q)=1.365×10^{-5} *19*
98.10 *1*	1.65×10^{-3} *14*	137.711	9/2$^-$	39.614	5/2$^-$	E2		22.31 *31*	α(L)=16.09 *23*; α(M)=4.57 *6* α(N)=1.279 *18*; α(O)=0.313 *4*; α(P)=0.0520 *7*; α(Q)=0.0002150 *30* Mult.,δ: L2:L3:M2:M3=100: 60: 30: 18 (1965Ho13).

$^{249}_{97}Bk_{152}$-7

^{253}Es α decay (20.47 d) 2005Ah03,1975Ah01 (continued)

γ(^{249}Bk) (continued)

E_γ[†]	I_γ[†&]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[@]	Comments
98.2[‡] *2*	≈3×10^{-7}[‡]	704.84	(11/2$^-$)	606.691	(7/2$^-$)			
100.5[‡] *3*	≈4×10^{-6}[‡]	473.66	(17/2$^-$)	373.179	(15/2$^-$)			
102.8[‡] *3*	≈1×10^{-7}[‡]	709.15	(5/2$^-$)	606.691	(7/2$^-$)			
114.04 *1*	4.7×10^{-4} *3*	155.854	13/2$^+$	41.805	9/2$^+$	(E2)	11.12 *16*	α(L)=8.03 *11*; α(M)=2.278 *32* α(N)=0.637 *9*; α(O)=0.1564 *22*; α(P)=0.0261 *4*; α(Q)=0.0001227 *17* Mult.: L2/L3=1.6 (1965Ho13).
121.98 *1*	1.15×10^{-3} *10*	204.572	(11/2$^-$)	82.595	7/2$^-$	(E2)	8.17 *11*	α(L)=5.90 *8*; α(M)=1.673 *23* α(N)=0.468 *7*; α(O)=0.1149 *16*; α(P)=0.01919 *27*; α(Q)=9.63×10^{-5} *13* Mult.: L2/L3=1.5 (1965Ho13).
122.1[‡]	<1×10^{-6}[‡]	597.835	(13/2$^+$)	475.002	(9/2$^+$)			
134.9[‡]	<1×10^{-6}[‡]	654.1		519.189	(9/2$^+$)			
135.51 *1*	1.9×10^{-4} *2*	229.242	(15/2$^+$)	93.759	11/2$^+$	[E2]	5.21 *7*	α(K)=0.1361 *19*; α(L)=3.66 *5*; α(M)=1.038 *15* α(N)=0.290 *4*; α(O)=0.0713 *10*; α(P)=0.01195 *17*; α(Q)=6.68×10^{-5} *9*
136.81 *2*	3.5×10^{-5} *3*	558.179	(3/2$^-$)	421.376	(5/2$^+$)	[E1]	0.257 *4*	α(K)=0.1920 *27*; α(L)=0.0484 *7*; α(M)=0.01196 *17* α(N)=0.00327 *5*; α(O)=0.000814 *11*; α(P)=0.0001449 *20*; α(Q)=6.42×10^{-6} *9*
137.71 *5*	1.0×10^{-5} *2*	137.711	9/2$^-$	0.0	7/2$^+$			
145.42 *1*	3.3×10^{-4} *2*	283.131	(13/2$^-$)	137.711	9/2$^-$	E2	3.85 *5*	α(K)=0.1560 *22*; α(L)=2.67 *4*; α(M)=0.755 *11* α(N)=0.2114 *30*; α(O)=0.0519 *7*; α(P)=0.00872 *12*; α(Q)=5.27×10^{-5} *7* Mult.: L2/L3=1.2 (1965Ho13).
152.2 *2*	≈2×10^{-7}	671.089	(13/2$^+$)	519.189	(9/2$^+$)			
156.08 *8*	1.5×10^{-5} *3*	311.857	(17/2$^+$)	155.854	13/2$^+$			
162.7 *1*	1.5×10^{-5} *4*	204.572	(11/2$^-$)	41.805	9/2$^+$	[E1]	0.1738 *24*	α(K)=0.1320 *19*; α(L)=0.0314 *4*; α(M)=0.00773 *11* α(N)=0.002114 *30*; α(O)=0.000528 *7*; α(P)=9.53×10^{-5} *13*; α(Q)=4.44×10^{-6} *6*
164.4[‡] *3*	≈3×10^{-7}[‡]	932.19	(7/2$^-$)	767.89	(9/2$^-$)	[M1]	8.44 *13*	α(K)=6.60 *10*; α(L)=1.381 *21*; α(M)=0.339 *5* α(N)=0.0934 *14*; α(O)=0.0240 *4*; α(P)=0.00474 *7*; α(Q)=0.000333 *5*
168.57 *8*	5.3×10^{-5} *5*	373.179	(15/2$^-$)	204.572	(11/2$^-$)	[E2]	2.083 *29*	α(K)=0.1629 *23*; α(L)=1.387 *20*; α(M)=0.392 *6* α(N)=0.1096 *16*; α(O)=0.0270 *4*; α(P)=0.00456 *6*; α(Q)=3.28×10^{-5} *5*
168.8[a‡] *2*	≈5×10^{-6}[a‡]	558.179	(3/2$^-$)	389.170	(5/2$^+$)	[E1]	0.1599 *23*	α(K)=0.1217 *17*; α(L)=0.0286 *4*; α(M)=0.00705 *10* α(N)=0.001929 *28*; α(O)=0.000482 *7*; α(P)=8.72×10^{-5} *12*; α(Q)=4.11×10^{-6} *6*
168.8[a‡] *2*	≈5×10^{-6}[a‡]	597.835	(13/2$^+$)	428.955	(7/2$^+$)			
177.6[‡]	<1×10^{-6}[‡]	606.691	(7/2$^-$)	428.955	(7/2$^+$)			
180.52 *8*	2.1×10^{-5} *3*	558.179	(3/2$^-$)	377.552	(1/2$^+$)	[E1]	0.1373 *19*	α(K)=0.1049 *15*; α(L)=0.02426 *34*; α(M)=0.00597 *8* α(N)=0.001633 *23*; α(O)=0.000409 *6*; α(P)=7.43×10^{-5} *10*; α(Q)=3.57×10^{-6} *5*

^{253}Es α decay (20.47 d) 2005Ah03,1975Ah01 (continued)

γ(^{249}Bk) (continued)

E_γ[†]	I_γ[†&]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[@]	Comments
185.3 *1*	8.0×10^{-6} *20*	606.691	(7/2$^-$)	421.376	(5/2$^+$)			
185.6[‡] *2*	≈1×10^{-6}[‡]	704.84	(11/2$^-$)	519.189	(9/2$^+$)			
189.4 *1*	≈5×10^{-6}	283.131	(13/2$^-$)	93.759	11/2$^+$			
190.5 *3*	≈5×10^{-6}	473.66	(17/2$^-$)	283.131	(13/2$^-$)			
191.7[‡] *2*	≈7×10^{-7}[‡]	569.21	(1/2$^-$)	377.552	(1/2$^+$)	[E1]	0.1198 *17*	α(K)=0.0918 *13*; α(L)=0.02094 *30*; α(M)=0.00515 *7* α(N)=0.001409 *20*; α(O)=0.000353 *5*; α(P)=6.44×10^{-5} *9*; α(Q)=3.15×10^{-6} *4*
192.0[‡] *2*	≈6×10^{-7}[‡]	711.15	(7/2$^-$)	519.189	(9/2$^+$)			
203.1[a‡] *5*	≈3×10^{-7}[a‡]	624.30	(5/2$^+$)	421.376	(5/2$^+$)			
203.1[a‡] *5*	≈3×10^{-7}[a‡]	624.93	(5/2$^-$)	421.376	(5/2$^+$)			
204.0[‡]	<1×10^{-6}[‡]	723.17	(9/2$^-$)	519.189	(9/2$^+$)			E$_\gamma$: the transition was observed between 723.2 and 519.2. The difference in energy=204.0, while the authors report 202.1 keV. This value does not fit the level scheme. Therefore, the evaluator adopts 204.0.
227.0 *3*	≈5×10^{-6}	899.63	(3/2$^-$)	672.81	(5/2$^-$)			
227.1[‡] *2*	≈2×10^{-6}[‡]	769.15	(9/2$^+$)	542.095	(11/2$^+$)			
228.4[‡] *2*	≈1×10^{-6}[‡]	703.42	(7/2$^+$)	475.002	(9/2$^+$)			
[x]229.0[‡]	<1×10^{-6}[‡]							
231.7[‡]	<1×10^{-6}[‡]	642.74	(1/2$^-$)	410.71	(3/2$^+$)			
235.1[‡] *2*	≈3×10^{-6}[‡]	624.30	(5/2$^+$)	389.170	(5/2$^+$)			
236.1[‡] *2*	≈2×10^{-6}[‡]	711.15	(7/2$^-$)	475.002	(9/2$^+$)			
244.0[‡] *2*	≈1×10^{-6}[‡]	672.81	(5/2$^-$)	428.955	(7/2$^+$)			
247.7[‡]	<1×10^{-6}[‡]	723.17	(9/2$^-$)	475.002	(9/2$^+$)			
258.9[‡] *2*	≈2×10^{-6}[‡]	542.095	(11/2$^+$)	283.131	(13/2$^-$)			
261.7[‡] *3*	≈8×10^{-7}[‡]	934.64	(5/2$^-$)	672.81	(5/2$^-$)			
264.1[‡]	<1×10^{-6}[‡]	642.74	(1/2$^-$)	377.552	(1/2$^+$)			
[x]264.7[‡]	<1×10^{-6}[‡]							E$_\gamma$: assignment to ^{253}Es decay is tentative.
270.46 *8*	1.8×10^{-5} *2*	475.002	(9/2$^+$)	204.572	(11/2$^-$)			
274.5[‡] *2*	≈1×10^{-6}[‡]	703.42	(7/2$^+$)	428.955	(7/2$^+$)			
282.2[‡] *2*	≈1×10^{-6}[‡]	711.15	(7/2$^-$)	428.955	(7/2$^+$)			
283.7[a] *2*	≈5×10^{-6}[a]	661.35	(3/2$^-$)	377.552	(1/2$^+$)			
283.7[a] *2*	≈5×10^{-6}[a]	672.81	(5/2$^-$)	389.170	(5/2$^+$)			
291.26 *8*	3.4×10^{-5} *3*	428.955	(7/2$^+$)	137.711	9/2$^-$	[E1]	0.0475 *7*	α(K)=0.0371 *5*; α(L)=0.00779 *11*; α(M)=0.001905 *27* α(N)=0.000522 *7*; α(O)=0.0001318 *18*; α(P)=2.459×10^{-5} *34*; α(Q)=1.336×10^{-6} *19*
294.1[‡] *2*	≈1×10^{-6}[‡]	769.15	(9/2$^+$)	475.002	(9/2$^+$)			

$^{249}_{97}Bk_{152}$-9

γ(^{249}Bk) (continued)

E_γ [†]	I_γ [†&]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[@]	Comments
300.3[‡]	<1×10^{-6}[‡]	709.15	(5/2$^-$)	410.71	(3/2$^+$)			E_γ: Poor fit. Level energy difference=408.85.
306.58 *8*	2.4×10^{-5} *2*	389.170	(5/2$^+$)	82.595	7/2$^-$	[E1]	0.0426 *6*	α(K)=0.0334 *5*; α(L)=0.00694 *10*; α(M)=0.001695 *24* α(N)=0.000464 *7*; α(O)=0.0001173 *16*; α(P)=2.195×10^{-5} *31*; α(Q)=1.206×10^{-6} *17*
312.7 *1*	4.5×10^{-6} *6*	542.095	(11/2$^+$)	229.242	(15/2$^+$)	[E2]	0.2243 *31*	α(K)=0.0756 *11*; α(L)=0.1080 *15*; α(M)=0.0299 *4* α(N)=0.00835 *12*; α(O)=0.002068 *29*; α(P)=0.000361 *5*; α(Q)=6.00×10^{-6} *8*
314.2[‡] *2*	≈2×10^{-6}[‡]	703.42	(7/2$^+$)	389.170	(5/2$^+$)			
319.16 *5*	3.7×10^{-5} *3*	475.002	(9/2$^+$)	155.854	13/2$^+$	[E2]	0.2106 *30*	α(K)=0.0731 *10*; α(L)=0.0999 *14*; α(M)=0.0276 *4* α(N)=0.00771 *11*; α(O)=0.001911 *27*; α(P)=0.000334 *5*; α(Q)=5.70×10^{-6} *8*
330.7[‡]	<1×10^{-6}[‡]	709.15	(5/2$^-$)	377.552	(1/2$^+$)			
335.20 *5*	1.40×10^{-4} *15*	428.955	(7/2$^+$)	93.759	11/2$^+$	[E2]	0.1816 *25*	α(K)=0.0674 *9*; α(L)=0.0830 *12*; α(M)=0.02291 *32* α(N)=0.00639 *9*; α(O)=0.001584 *22*; α(P)=0.000278 *4*; α(Q)=5.07×10^{-6} *7*
337.30 *5*	5.2×10^{-5} *4*	475.002	(9/2$^+$)	137.711	9/2$^-$	[E1]	0.0349 *5*	α(K)=0.0274 *4*; α(L)=0.00560 *8*; α(M)=0.001367 *19* α(N)=0.000375 *5*; α(O)=9.48×10^{-5} *13*; α(P)=1.781×10^{-5} *25*; α(Q)=1.000×10^{-6} *14*
340.2 *5*	≈5×10^{-7}	769.15	(9/2$^+$)	428.955	(7/2$^+$)			
346.37 *5*	1.6×10^{-4} *2*	428.955	(7/2$^+$)	82.595	7/2$^-$	[E1]	0.0330 *5*	α(K)=0.0260 *4*; α(L)=0.00528 *7*; α(M)=0.001289 *18* α(N)=0.000353 *5*; α(O)=8.94×10^{-5} *13*; α(P)=1.682×10^{-5} *24*; α(Q)=9.50×10^{-7} *13*
347.34 *5*	2.0×10^{-4} *3*	389.170	(5/2$^+$)	41.805	9/2$^+$	[E2]	0.1635 *23*	α(K)=0.0635 *9*; α(L)=0.0727 *10*; α(M)=0.02002 *28* α(N)=0.00558 *8*; α(O)=0.001385 *19*; α(P)=0.0002437 *34*; α(Q)=4.66×10^{-6} *7*
349.56 *5*	1.4×10^{-4} *2*	389.170	(5/2$^+$)	39.614	5/2$^-$	[E1]	0.0324 *5*	α(K)=0.0255 *4*; α(L)=0.00518 *7*; α(M)=0.001263 *18* α(N)=0.000346 *5*; α(O)=8.76×10^{-5} *12*; α(P)=1.649×10^{-5} *23*; α(Q)=9.33×10^{-7} *13*
368.77[a] *2*	3.6×10^{-4}[a] *2*	377.552	(1/2$^+$)	8.771	3/2$^-$			
368.77[a] *2*	3.6×10^{-4}[a] *2*	597.835	(13/2$^+$)	229.242	(15/2$^+$)	(M1,E2)	0.5 *4*	α(K)=0.38 *32*; α(L)=0.10 *4*; α(M)=0.026 *9* α(N)=0.0071 *26*; α(O)=0.0018 *7*; α(P)=3.4×10^{-4} *15*; α(Q)=1.9×10^{-5} *15* E_γ: poor fit possibly due to doublet. Level-energy difference=368.59. Mult.: α(K)exp=0.42 *11* (1971HoZQ).
381.23 *2*	5.5×10^{-3} *3*	475.002	(9/2$^+$)	93.759	11/2$^+$	(M1)	0.807 *11*	α(K)=0.633 *9*; α(L)=0.1305 *18*; α(M)=0.0319 *4* α(N)=0.00880 *12*; α(O)=0.002264 *32*; α(P)=0.000447 *6*; α(Q)=3.12×10^{-5} *4* Mult.: α(K)exp=0.62 *6* (1971HoZQ).

$^{249}_{97}$Bk$_{152}$-10

^{253}Es α decay (20.47 d) 2005Ah03,1975Ah01 (continued)

γ(^{249}Bk) (continued)

E_γ[†]	I_γ[†&]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	α[@]	Comments
387.15 *2*	1.90×10^{-2} *10*	428.955	(7/2$^+$)	41.805	9/2$^+$	M1		0.774 *11*	α(K)=0.607 *8*; α(L)=0.1250 *18*; α(M)=0.0306 *4* α(N)=0.00843 *12*; α(O)=0.002170 *30*; α(P)=0.000428 *6*; α(Q)=2.99×10^{-5} *4* Mult.: α(K)exp=0.61 *7* (1971HoZQ), K/L=4.5, L1/L2=10 (1965Ho13).
389.17 *2*	2.70×10^{-2} *10*	389.170	(5/2$^+$)	0.0	7/2$^+$	M1		0.763 *11*	α(K)=0.598 *8*; α(L)=0.1232 *17*; α(M)=0.0302 *4* α(N)=0.00831 *12*; α(O)=0.002139 *30*; α(P)=0.000422 *6*; α(Q)=2.95×10^{-5} *4* Mult.: K:L1:L2:L3=500:100:10:AP 0.5 (1965Ho13).
392.42 *5*	4.4×10^{-5} *4*	475.002	(9/2$^+$)	82.595	7/2$^-$	[E1]		0.0256 *4*	α(K)=0.02020 *28*; α(L)=0.00403 *6*; α(M)=0.000981 *14* α(N)=0.000269 *4*; α(O)=6.82×10^{-5} *10*; α(P)=1.289×10^{-5} *18*; α(Q)=7.48×10^{-7} *10*
402.0[a] *1*	5.0×10^{-6}[a] *10*	410.71	(3/2$^+$)	8.771	3/2$^-$				
402.0[a] *1*	5.0×10^{-6}[a] *10*	606.691	(7/2$^-$)	204.572	(11/2$^-$)				
404.4 *1*	8.0×10^{-6} *8*	542.095	(11/2$^+$)	137.711	9/2$^-$	[E1]		0.02406 *34*	α(K)=0.01903 *27*; α(L)=0.00378 *5*; α(M)=0.000919 *13* α(N)=0.0002519 *35*; α(O)=6.39×10^{-5} *9*; α(P)=1.210×10^{-5} *17*; α(Q)=7.06×10^{-7} *10*
416.3 *2*	1.4×10^{-6} *3*	498.68	(7/2$^+$)	82.595	7/2$^-$				
421.39 *3*	8.5×10^{-5} *4*	421.376	(5/2$^+$)	0.0	7/2$^+$	[M1,E2]		0.35 *26*	α(K)=0.26 *22*; α(L)=0.068 *31*; α(M)=0.017 *7* α(N)=0.0047 *20*; α(O)=0.0012 *5*; α(P)=2.3×10^{-4} *11*; α(Q)=1.3×10^{-5} *10*
421.7[‡] *2*	≈8×10^{-6}[‡]	704.84	(11/2$^-$)	283.131	(13/2$^-$)				
425.43 *2*	2.22×10^{-4} *15*	519.189	(9/2$^+$)	93.759	11/2$^+$	[E2]		0.0934 *13*	α(K)=0.0452 *6*; α(L)=0.0352 *5*; α(M)=0.00956 *13* α(N)=0.00266 *4*; α(O)=0.000663 *9*; α(P)=0.0001184 *17*; α(Q)=2.93×10^{-6} *4*
428.95 *2*	5.55×10^{-3} *20*	428.955	(7/2$^+$)	0.0	7/2$^+$	M1+E2	0.29 *18*	0.55 *5*	α(K)=0.43 *4*; α(L)=0.090 *6*; α(M)=0.0220 *15* α(N)=0.0061 *4*; α(O)=0.00156 *10*; α(P)=0.000307 *22*; α(Q)=2.10×10^{-5} *21* Mult.,δ: α(K)exp=0.42 *3* (1971HoZQ), K/L12=4.2, L1/L2=10 (1965Ho13).
433.20 *2*	2.7×10^{-3} *2*	475.002	(9/2$^+$)	41.805	9/2$^+$	(M1)		0.569 *8*	α(K)=0.447 *6*; α(L)=0.0918 *13*; α(M)=0.02244 *31* α(N)=0.00619 *9*; α(O)=0.001592 *22*; α(P)=0.000314 *4*; α(Q)=2.194×10^{-5} *31* Mult.: α(K)exp=0.46 *3* (1971HoZQ).
436.8 *4*	≈1.0×10^{-6}	519.189	(9/2$^+$)	82.595	7/2$^-$				
441.83[a] *2*	7.9×10^{-5}[a] *8*	597.835	(13/2$^+$)	155.854	13/2$^+$	(M1)		0.539 *8*	α(K)=0.423 *6*; α(L)=0.0869 *12*; α(M)=0.02126 *30* α(N)=0.00586 *8*; α(O)=0.001508 *21*; α(P)=0.000298 *4*; α(Q)=2.078×10^{-5} *29* E_γ: poor fit possibly due to doublet. Level-energy

$^{249}_{97}Bk_{152}$-11

^{253}Es α decay (20.47 d) 2005Ah03,1975Ah01 (continued)

γ(^{249}Bk) (continued)

E_γ [†]	I_γ [†&]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	α[@]	Comments
									difference=441.98. Mult.: α(K)exp=0.44 *13* (1971HoZQ).
441.83[a] *2*	7.9×10^{-5}[a] *8*	671.089	(13/2$^+$)	229.242	(15/2$^+$)				
448.34 *2*	6.4×10^{-4} *3*	542.095	(11/2$^+$)	93.759	11/2$^+$	(M1+E2)	0.52 *+17−18*	0.43 *5*	α(K)=0.33 *4*; α(L)=0.072 *6*; α(M)=0.0178 *14* α(N)=0.0049 *4*; α(O)=0.00126 *10*; α(P)=0.000246 *21*; α(Q)=1.63×10^{-5} *19* Mult.,δ: α(K)exp=0.33 *4* (1971HoZQ).
455.1[‡]	<1×10^{-6}[‡]	1223.01	(7/2$^+$)	767.89	(9/2$^-$)				
456.84 *8*	1.6×10^{-5} *2*	498.68	(7/2$^+$)	41.805	9/2$^+$				
469.00 *5*	8.0×10^{-5} *7*	606.691	(7/2$^-$)	137.711	9/2$^-$	[M1,E2]		0.27 *19*	α(K)=0.20 *16*; α(L)=0.050 *24*; α(M)=0.012 *6* α(N)=0.0034 *15*; α(O)=9.E−4 *4*; α(P)=1.7×10^{-4} *8*; α(Q)=1.0×10^{-5} *8*
472.6 *2*	4×10^{-6} *1*	701.85	(15/2$^+$)	229.242	(15/2$^+$)				
475.00 *5*	3.2×10^{-4} *2*	475.002	(9/2$^+$)	0.0	7/2$^+$	(M1)		0.443 *6*	α(K)=0.348 *5*; α(L)=0.0713 *10*; α(M)=0.01743 *24* α(N)=0.00480 *7*; α(O)=0.001236 *17*; α(P)=0.0002439 *34*; α(Q)=1.703×10^{-5} *24* Mult.: α(K)exp=0.32 *4* (1971HoZQ).
477.40 *5*	1.12×10^{-4} *10*	519.189	(9/2$^+$)	41.805	9/2$^+$	[M1,E2]		0.25 *18*	α(K)=0.19 *15*; α(L)=0.047 *23*; α(M)=0.012 *5* α(N)=0.0033 *15*; α(O)=8.E−4 *4*; α(P)=1.6×10^{-4} *8*; α(Q)=1.0×10^{-5} *7*
[x]482.1 *5*	≈1.0×10^{-6}								
498.6 *2*	5.7×10^{-6} *6*	498.68	(7/2$^+$)	0.0	7/2$^+$				
500.30[a] *5*	1.43×10^{-4}[a] *12*	542.095	(11/2$^+$)	41.805	9/2$^+$	(M1)		0.384 *5*	α(K)=0.302 *4*; α(L)=0.0618 *9*; α(M)=0.01512 *21* α(N)=0.00417 *6*; α(O)=0.001072 *15*; α(P)=0.0002116 *30*; α(Q)=1.478×10^{-5} *21* Mult.: α(K)exp=0.28 *9* (1971HoZQ).
500.30[a] *5*	1.43×10^{-4}[a] *12*	704.84	(11/2$^-$)	204.572	(11/2$^-$)				
503.93 *5*	2.1×10^{-5} *2*	597.835	(13/2$^+$)	93.759	11/2$^+$	[M1,E2]		0.22 *16*	α(K)=0.16 *13*; α(L)=0.040 *20*; α(M)=0.010 *5* α(N)=0.0028 *13*; α(O)=7.1×10^{-4} *34*; α(P)=1.4×10^{-4} *7*; α(Q)=8.E−6 *6*
515.5 *1*	3.5×10^{-6} *6*	671.089	(13/2$^+$)	155.854	13/2$^+$				
518.60[a] *8*	1.02×10^{-4}[a] *10*	558.179	(3/2$^-$)	39.614	5/2$^-$	[M1,E2]		0.20 *15*	α(K)=0.15 *12*; α(L)=0.037 *19*; α(M)=0.009 *4* α(N)=0.0026 *12*; α(O)=6.6×10^{-4} *32*; α(P)=1.3×10^{-4} *7*; α(Q)=8.E−6 *6*
518.60[a] *8*	1.02×10^{-4}[a] *10*	723.17	(9/2$^-$)	204.572	(11/2$^-$)				
524.10 *5*	5.2×10^{-5} *5*	606.691	(7/2$^-$)	82.595	7/2$^-$	[M1,E2]		0.20 *14*	α(K)=0.15 *12*; α(L)=0.036 *18*; α(M)=0.009 *4* α(N)=0.0025 *12*; α(O)=6.4×10^{-4} *31*; α(P)=1.2×10^{-4} *6*; α(Q)=7.E−6 *6*
530.0 *3*	≈1.0×10^{-6}	569.21	(1/2$^-$)	39.614	5/2$^-$	[E2]		0.0544 *8*	α(K)=0.0311 *4*; α(L)=0.01704 *24*; α(M)=0.00455 *6*

$^{249}_{97}Bk_{152}$-12

^{253}Es α decay (20.47 d) 2005Ah03,1975Ah01 (continued)

γ(^{249}Bk) (continued)

E_γ [†]	I_γ [†&]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [#]	δ [#]	α [@]	Comments
									α(N)=0.001266 *18*; α(O)=0.000317 *4*; α(P)=5.75×10^{-5} *8*; α(Q)=1.821×10^{-6} *26*
542.30 *5*	2.2×10^{-5} *2*	624.93	(5/2$^-$)	82.595	7/2$^-$				
545.9 *3*	1.5×10^{-6} *3*	701.85	(15/2$^+$)	155.854	13/2$^+$				
549.40 *5*	3.0×10^{-5} *2*	558.179	(3/2$^-$)	8.771	3/2$^-$	[M1,E2]		0.17 *12*	α(K)=0.13 *10*; α(L)=0.032 *16*; α(M)=0.008 *4* α(N)=0.0022 *11*; α(O)=5.6×10^{-4} *27*; α(P)=1.1×10^{-4} *6*; α(Q)=7.E−6 *5*
555.8 *3*	1.2×10^{-6} *3*	597.835	(13/2$^+$)	41.805	9/2$^+$				
560.42 *5*	3.5×10^{-5} *3*	569.21	(1/2$^-$)	8.771	3/2$^-$	(M1+E2)	0.75 *20*	0.198 *30*	α(K)=0.152 *25*; α(L)=0.034 *4*; α(M)=0.0085 *9* α(N)=0.00234 *26*; α(O)=0.00060 *7*; α(P)=0.000117 *14*; α(Q)=7.5×10^{-6} *12* Mult.,δ: From Adopted Gammas.
567.10[a] *5*	4.5×10^{-5}[a] *3*	606.691	(7/2$^-$)	39.614	5/2$^-$	[M1,E2]		0.16 *11*	α(K)=0.12 *9*; α(L)=0.029 *15*; α(M)=0.0072 *35* α(N)=0.0020 *10*; α(O)=5.1×10^{-4} *25*; α(P)=1.0×10^{-4} *5*; α(Q)=6.E−6 *4*
567.10[a] *5*	4.5×10^{-5}[a] *3*	704.84	(11/2$^-$)	137.711	9/2$^-$				
571.0 *3*	≈1.0×10^{-6}	709.15	(5/2$^-$)	137.711	9/2$^-$				
577.6 *2*	1.5×10^{-6} *2*	671.089	(13/2$^+$)	93.759	11/2$^+$				
585.35 *5*	3.4×10^{-5} *2*	624.93	(5/2$^-$)	39.614	5/2$^-$	[M1,E2]		0.15 *10*	α(K)=0.11 *9*; α(L)=0.026 *14*; α(M)=0.0066 *33* α(N)=0.0018 *9*; α(O)=4.7×10^{-4} *23*; α(P)=9.E−5 *5*; α(Q)=6.E−6 *4*
590.1[‡] *3*	≈1.0×10^{-6}[‡]	672.81	(5/2$^-$)	82.595	7/2$^-$				
608.2 *3*	≈5×10^{-7}	701.85	(15/2$^+$)	93.759	11/2$^+$				
616.1 *2*	3.6×10^{-6} *3*	624.93	(5/2$^-$)	8.771	3/2$^-$	[M1,E2]		0.13 *9*	α(K)=0.10 *7*; α(L)=0.023 *12*; α(M)=0.0057 *29* α(N)=0.0016 *8*; α(O)=4.0×10^{-4} *20*; α(P)=8.E−5 *4*; α(Q)=4.9×10^{-6} *35*
621.7 *2*	1.8×10^{-6} *2*	661.35	(3/2$^-$)	39.614	5/2$^-$				
624.3 *4*	7×10^{-7} *2*	624.30	(5/2$^+$)	0.0	7/2$^+$				
626.5 *2*	4.0×10^{-6} *3*	709.15	(5/2$^-$)	82.595	7/2$^-$				
633.0[‡] *3*	≈2.0×10^{-6}[‡]	672.81	(5/2$^-$)	39.614	5/2$^-$				
634.2 *2*	4.7×10^{-6} *4*	642.74	(1/2$^-$)	8.771	3/2$^-$				
640.6 *2*	3.4×10^{-6} *3*	723.17	(9/2$^-$)	82.595	7/2$^-$				
652.7 *2*	1.20×10^{-6} *15*	661.35	(3/2$^-$)	8.771	3/2$^-$				
661.6 *2*	2.4×10^{-6} *4*	703.42	(7/2$^+$)	41.805	9/2$^+$				
664.0 *2*	5.0×10^{-6} *5*	672.81	(5/2$^-$)	8.771	3/2$^-$				
669.5 *2*	5.8×10^{-6} *5*	709.15	(5/2$^-$)	39.614	5/2$^-$				
672.8 *2*	1.4×10^{-6} *3*	672.81	(5/2$^-$)	0.0	7/2$^+$				
700.3 *3*	4×10^{-7} *1*	709.15	(5/2$^-$)	8.771	3/2$^-$				

$^{249}_{97}Bk_{152}$-13

^{253}Es α decay (20.47 d) 2005Ah03,1975Ah01 (continued)

$\gamma(^{249}Bk)$ (continued)

E_γ [†]	I_γ [†&]	E_i(level)	J_i^π	E_f	J_f^π	Comments
703.6 *4*	≈2×10^{-7}	703.42	(7/2$^+$)	0.0	7/2$^+$	
721.6 *2*	1.5×10^{-6} *2*	1150.64	(5/2$^-$)	428.955	(7/2$^+$)	
726.1 *2*	5.4×10^{-6} *4*	767.89	(9/2$^-$)	41.805	9/2$^+$	
742.4 *3*	8.5×10^{-7} *10*	836.07	(11/2$^-$)	93.759	11/2$^+$	
748.0[‡]	<1×10^{-6}[‡]	1223.01	(7/2$^+$)	475.002	(9/2$^+$)	
755.3 *3*	1.2×10^{-6} *2*	911.16	(13/2$^-$)	155.854	13/2$^+$	
761.5 *2*	3.1×10^{-6} *3*	1150.64	(5/2$^-$)	389.170	(5/2$^+$)	
767.9 *1*	3.1×10^{-5} *2*	767.89	(9/2$^-$)	0.0	7/2$^+$	
794.0[‡] *2*	1.5×10^{-6}[‡] *2*	1223.01	(7/2$^+$)	428.955	(7/2$^+$)	
794.2 *2*	2.6×10^{-6} *3*	836.07	(11/2$^-$)	41.805	9/2$^+$	
817.4 *3*	5.0×10^{-6} *5*	911.16	(13/2$^-$)	93.759	11/2$^+$	
833.8 *2*	4.7×10^{-6} *4*	1223.01	(7/2$^+$)	389.170	(5/2$^+$)	
836.1 *2*	6.2×10^{-7} *8*	836.07	(11/2$^-$)	0.0	7/2$^+$	
838.5 *3*	1.2×10^{-6} *2*	932.19	(7/2$^-$)	93.759	11/2$^+$	
[x]842.0 *3*	9×10^{-7} *2*					
[x]847.0 *3*	6×10^{-7} *1*					
852.1 *2*	3.1×10^{-6} *2*	934.64	(5/2$^-$)	82.595	7/2$^-$	
860.3 *2*	6.0×10^{-6} *4*	899.63	(3/2$^-$)	39.614	5/2$^-$	
890.5[a] *2*	2.2×10^{-5}[a] *2*	899.63	(3/2$^-$)	8.771	3/2$^-$	
890.5[a] *2*	2.2×10^{-5}[a] *2*	932.19	(7/2$^-$)	41.805	9/2$^+$	
894.5 *2*	5.2×10^{-6} *5*	988.14?	(9/2$^-$)	93.759	11/2$^+$	
899.9 *1*	7.2×10^{-6} *5*	1055.82?	(11/2$^-$)	155.854	13/2$^+$	
932.17 *5*	4.1×10^{-5} *2*	932.19	(7/2$^-$)	0.0	7/2$^+$	
946.3 *1*	7.8×10^{-6} *5*	988.14?	(9/2$^-$)	41.805	9/2$^+$	
962.1 *1*	2.4×10^{-7} *4*	1055.82?	(11/2$^-$)	93.759	11/2$^+$	
[x]965.2 *3*	8×10^{-7} *2*					
981.3 *3*	≈1.0×10^{-7}	1075.05	9/2$^+$	93.759	11/2$^+$	
998.3 *1*	9.0×10^{-7} *9*	1227.54?	(15/2$^-$)	229.242	(15/2$^+$)	E_γ: Possible alternate placement as decay-out transition from a 1040 level. Assignment to 1228 level based on agreement with calculated energies using rotational constant deduced by 2005Ah03 for the 7/2[633]⊗0$^-$7/2$^-$ band.
[x]1005.3 *5*	≈4×10^{-7}					
1014.4 *5*	≈2×10^{-7}	1055.82?	(11/2$^-$)	41.805	9/2$^+$	
[x]1023.0 *5*	≈1.0×10^{-7}					
(1033.3 *calc*)	1.0×10^{-6} *calc*	1075.05	9/2$^+$	41.805	9/2$^+$	E_γ,I_γ: Eγ≈1033.3, Iγ≈1.0×10^{-6}; Iγ deduced from excess counts of 1031.85 peak in ^{250}Bk β-decay.
[x]1034.7 *5*	≈1.0×10^{-6}					
1040.15 *8*	3.0×10^{-6} *2*	1133.91?	(13/2$^-$)	93.759	11/2$^+$	E_γ: Possible alternate placement as decay-out transition from a 1040 level. Assignment

$^{249}_{97}Bk_{152}$-14

γ(^{249}Bk) (continued)

E_γ †	I_γ †&	E_i(level)	J_i^π	E_f	J_f^π	Comments
						to 1134 level based on agreement with calculated energies using rotational constant deduced by 2005Ah03 for the 7/2[633]⊗0$^-$7/2$^-$ band.
[x]1042.3 *5*	≈1.7×10^{-7}					
1050.0 *2*	4.2×10^{-7} *5*	1143.78	11/2$^+$	93.759	11/2$^+$	
[x]1057.1 *5*	3.8×10^{-7} *6*					
1075.05 *8*	5.8×10^{-6} *4*	1075.05	9/2$^+$	0.0	7/2$^+$	
1102.0 *2*	1.4×10^{-6} *2*	1143.78	11/2$^+$	41.805	9/2$^+$	
[x]1106.0 *2*	1.8×10^{-6} *2*					
1150.7 *2*	8.0×10^{-7} *8*	1150.64	(5/2$^-$)	0.0	7/2$^+$	
1181.3 *2*	1.0×10^{-6} *1*	1223.01	(7/2$^+$)	41.805	9/2$^+$	
1223.0 *2*	6.0×10^{-7} *6*	1223.01	(7/2$^+$)	0.0	7/2$^+$	

† From γ-ray singles data of 2005Ah03, unless otherwise stated. Absolute γ-ray intensities were determined by measuring the alphas from the decay of ^{253}Es with a Si detector of known solid angle and gammas with a Ge spectrometer whose efficiency was determined with a calibrated source.

‡ Transition observed in γγ coin measurements in 2005Ah03. Iγ<1×10^{-6} per ^{253}Es α-decay estimated by the authors, unless stated otherwise. Energies for these weak γ rays determined with respect to energies of stronger γ rays measured in γ-ray singles spectra and that also have ΔEγ<0.2 keV. ΔEγ=1.0 keV assigned to these γ rays by the authors.

From experimental conversion coefficient data from 1965Ho13 and 1971HoZQ, except as noted. 1965Ho13 (M. D. Holtz, J. M. Hollander, R. L. Graham, T. Novakov) was a private communication to authors in the Table of Isotopes" (1967Le24,1978LeZA). No copy of 1965Ho13 is available at the National Nuclear Data Center; however, the evaluator has used the information presented in 1978LeZA. Uncertainties were not provided in 1978LeZA; however, the evaluator has estimated a 20% uncertainty for the ce data in 1978LeZA. The ce(K) data from 1971HoZQ was re-normalized to the M1 389.17 keV *2* gamma transition with α(K)(389.17)=0.598 *8* (BrIcc). Mixing ratio was calculated using the BrIccMixing code. Multipolarity and mixing ratios from this dataset are given in the Adopted Gammas.

@ Additional information 1.

& Absolute intensity per 100 decays.

[a] Multiply placed with undivided intensity.

[x] γ ray not placed in level scheme.

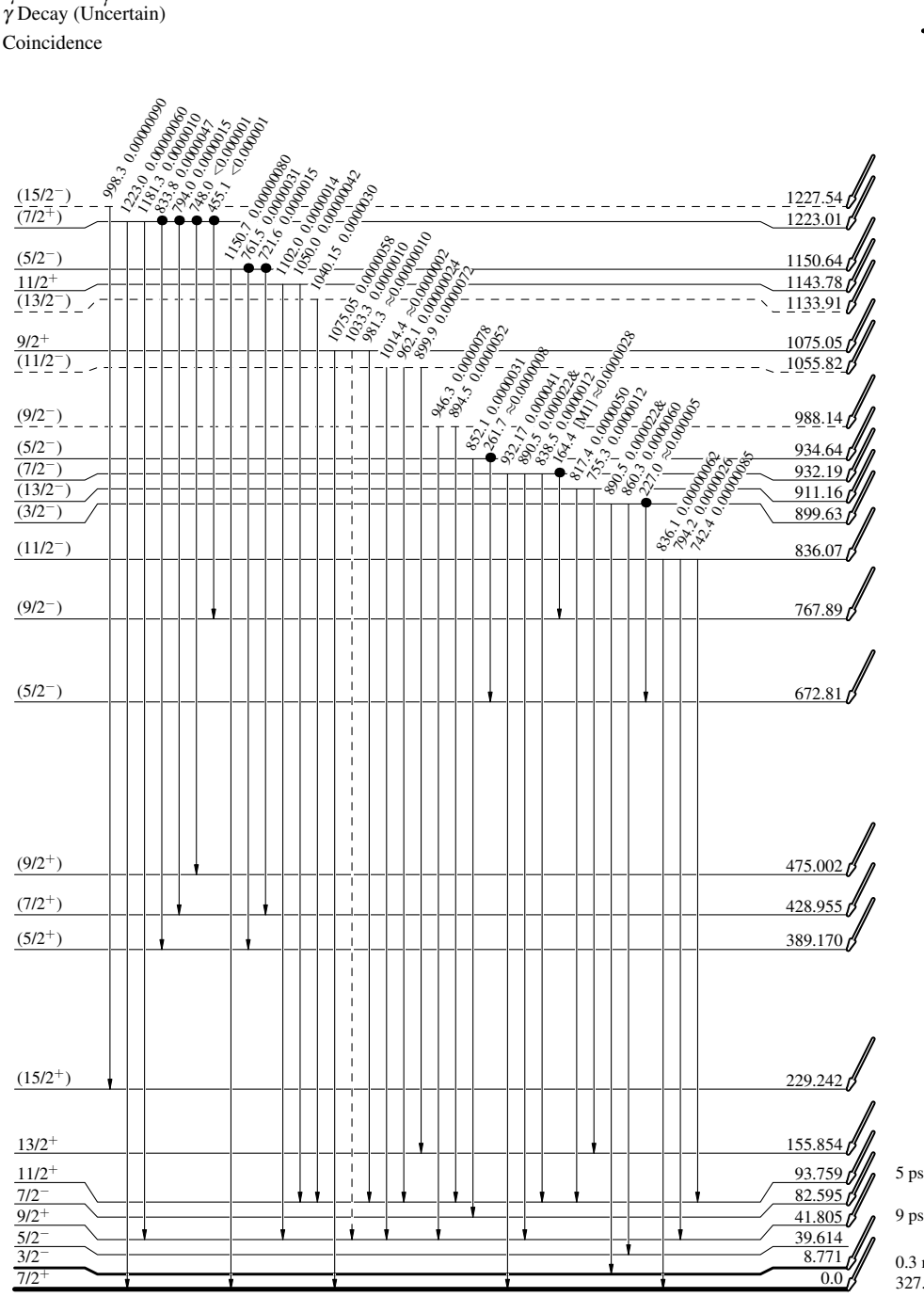
$^{249}_{97}$Bk$_{152}$-15

^{253}Es α decay (20.47 d) 2005Ah03,1975Ah01

Decay Scheme

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

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



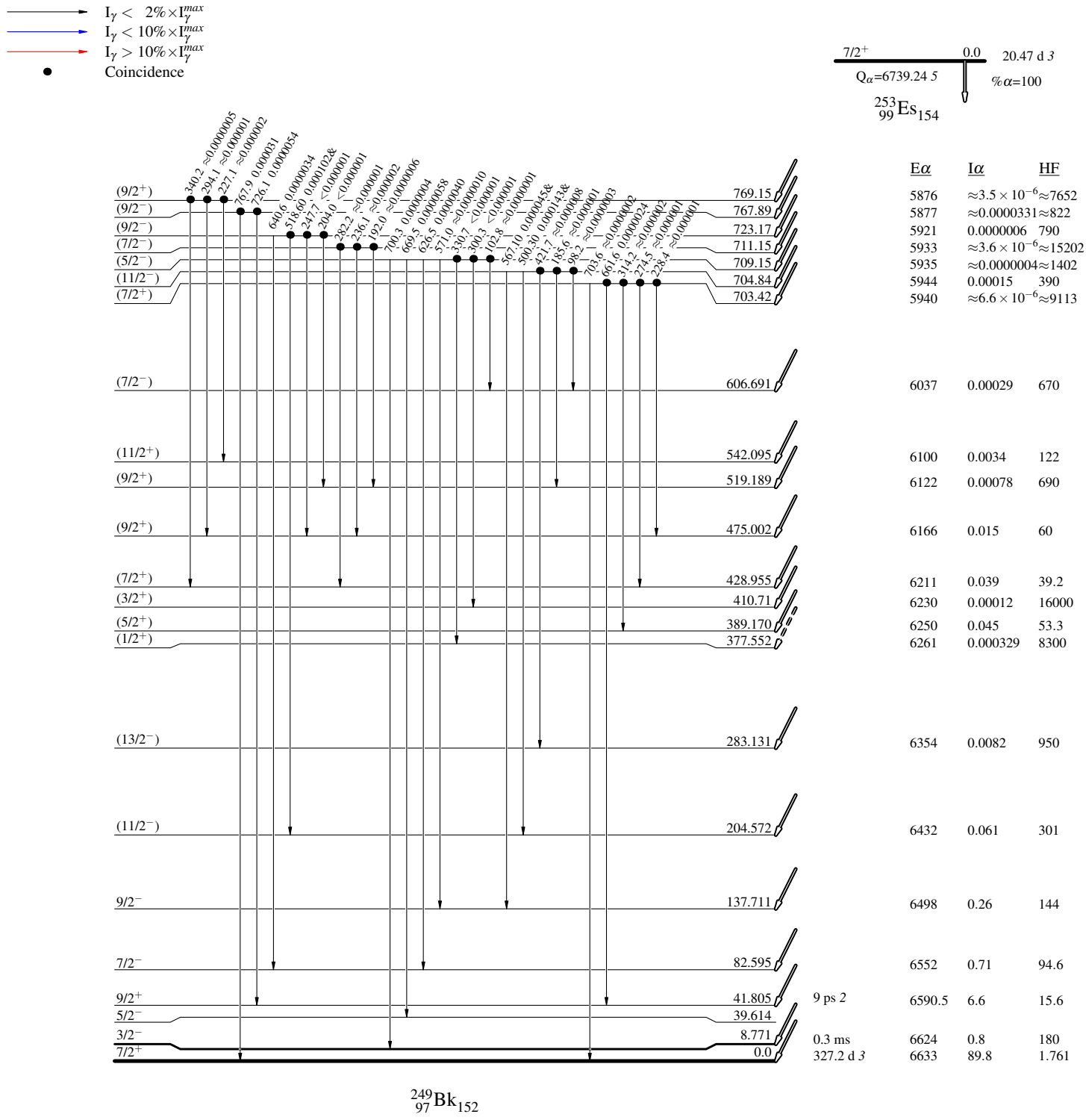
	Eα	Iα	HF
1227.54	5425	9.0×10^{-7}	70
1223.01	5429	8.8×10^{-6}	7.6
1150.64	5500	5.4×10^{-6}	34
1143.78	5507	1.82×10^{-6}	111
1133.91	5517	3.00×10^{-6}	77
1075.05	5575	5.9×10^{-6}	87
1055.82	5594	7.6×10^{-6}	87
988.14	5660	0.0000130	125
934.64	5713	$\approx 3.9 \times 10^{-6}$	≈841
932.19	5715	0.000057	59
911.16	5736	6.2×10^{-6}	717
899.63	5747	0.000023	220
836.07	5810	4.07×10^{-6}	2850
767.89	5877	≈0.0000331	≈822
672.81	5971	$\approx 7 \times 10^{-6}$	≈12466
475.002	6166	0.015	60
428.955	6211	0.039	39.2
389.170	6250	0.045	53.3
229.242	6408	0.013	1080
155.854	6480	0.085	364
93.759	6540	0.85	70.3
82.595	6552	0.71	94.6
41.805	6590.5	6.6	15.6
39.614	6624	0.8	180
8.771	6633	89.8	1.761
0.0			

$^{249}_{97}Bk_{152}$

^{253}Es α decay (20.47 d) 2005Ah03,1975Ah01

Decay Scheme (continued)

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



Eα	Iα	HF
5876	$\approx 3.5 \times 10^{-6}$	≈7652
5877	≈0.0000331	≈822
5921	0.0000006	790
5933	$\approx 3.6 \times 10^{-6}$	≈15202
5935	≈0.0000004	≈1402
5944	0.00015	390
5940	$\approx 6.6 \times 10^{-6}$	≈9113
6037	0.00029	670
6100	0.0034	122
6122	0.00078	690
6166	0.015	60
6211	0.039	39.2
6230	0.00012	16000
6250	0.045	53.3
6261	0.000329	8300
6354	0.0082	950
6432	0.061	301
6498	0.26	144
6552	0.71	94.6
6590.5	6.6	15.6
6624	0.8	180
6633	89.8	1.761

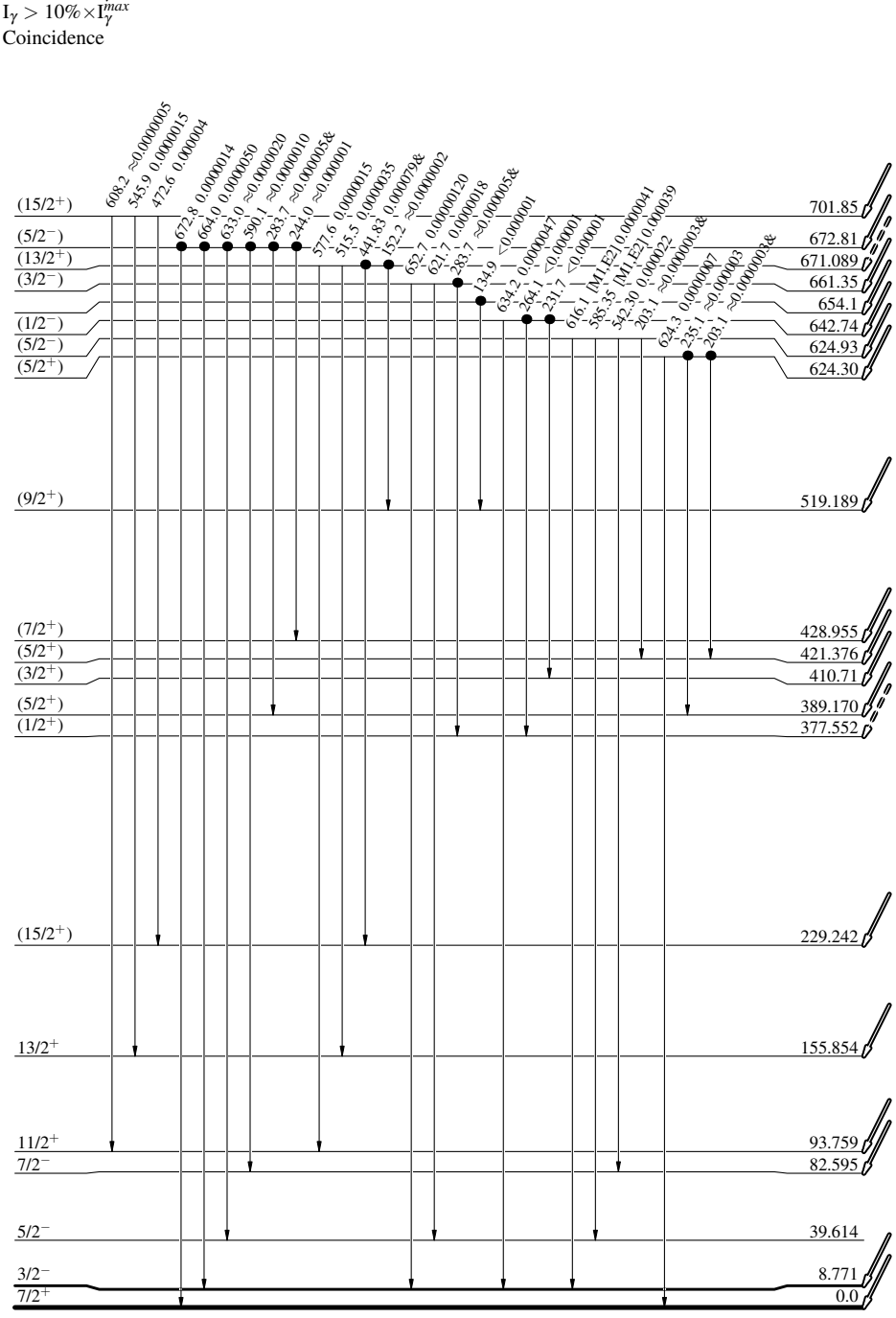
$^{249}_{97}Bk_{152}$

^{253}Es α decay (20.47 d) 2005Ah03,1975Ah01

Decay Scheme (continued)

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

Legend
$I_\gamma < 2\% \times I_\gamma^{max}$
$I_\gamma < 10\% \times I_\gamma^{max}$
$I_\gamma > 10\% \times I_\gamma^{max}$
Coincidence



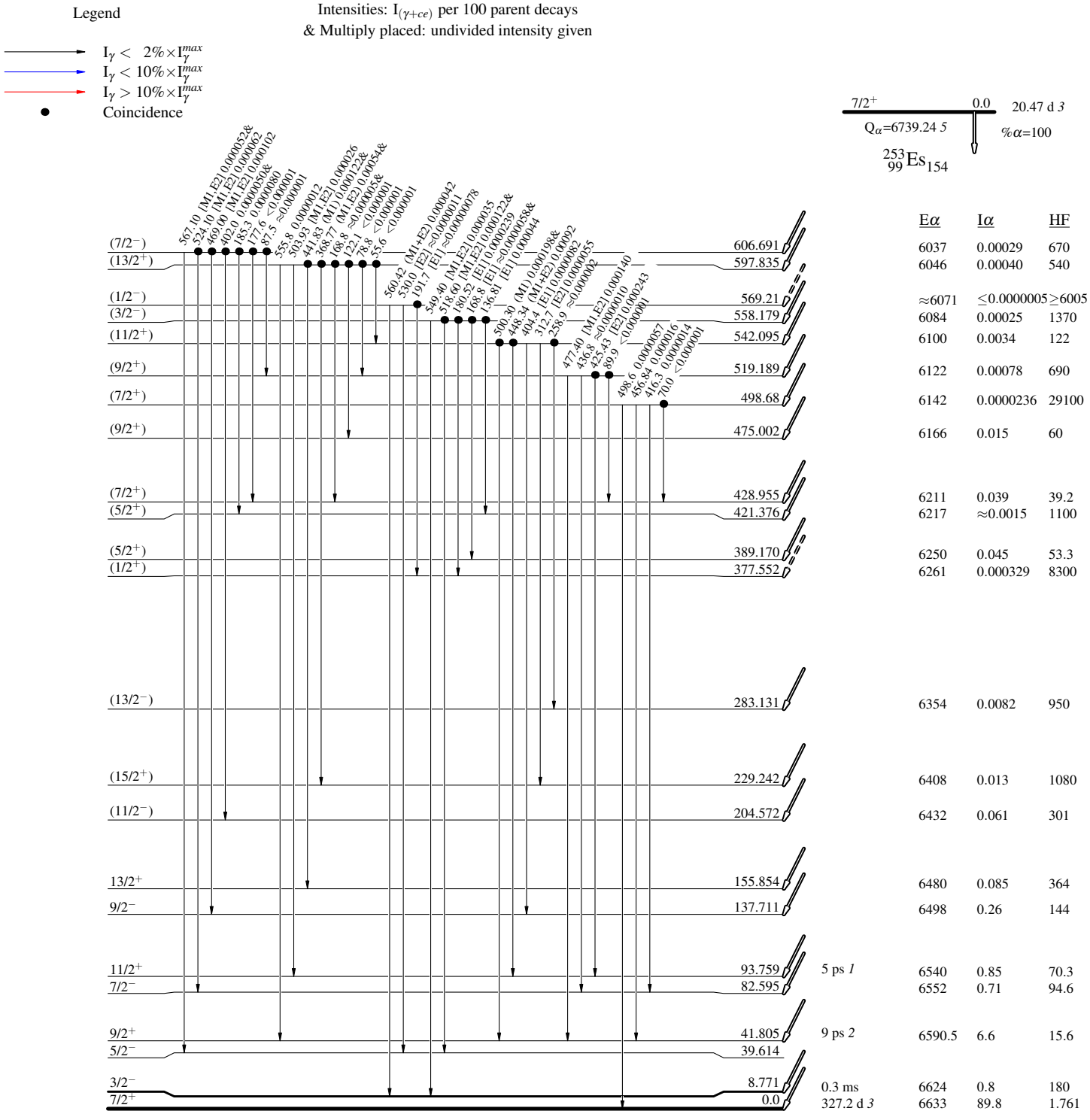
	Eα	Iα	HF
	5942	6.0×10^{-6}	10200
	5971	$\approx 7 \times 10^{-6}$	≈12466
	5972	≈0.0000006	≈1485
	5982	5.5×10^{-6}	18200
	5989	$<1.0 \times 10^{-6}$	>109005
	6000	5.7×10^{-6}	22000
	6019	0.00018	860
	6018	$\approx 3.9 \times 10^{-6}$	≈40112
	6122	0.00078	690
	6211	0.039	39.2
	6217	≈0.0015	1100
	6230	0.00012	16000
	6250	0.045	53.3
	6261	0.000329	8300
	6408	0.013	1080
	6480	0.085	364
	6540	0.85	70.3
	6552	0.71	94.6
	6624	0.8	180
	6633	89.8	1.761

$^{249}_{97}Bk_{152}$

^{253}Es α decay (20.47 d) 2005Ah03,1975Ah01

Decay Scheme (continued)

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

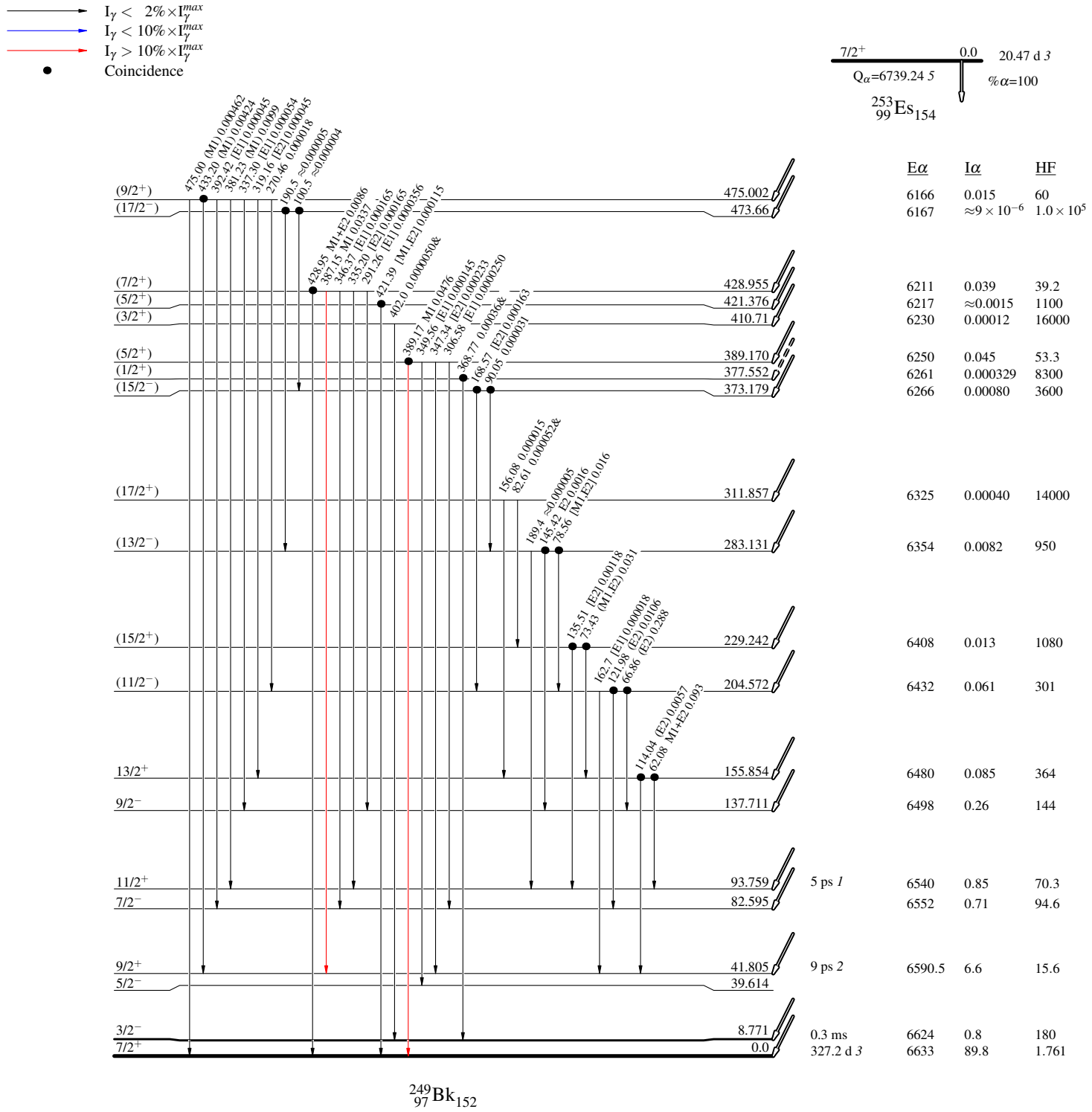


$^{249}_{97}Bk_{152}$

^{253}Es α decay (20.47 d) 2005Ah03,1975Ah01

Decay Scheme (continued)

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

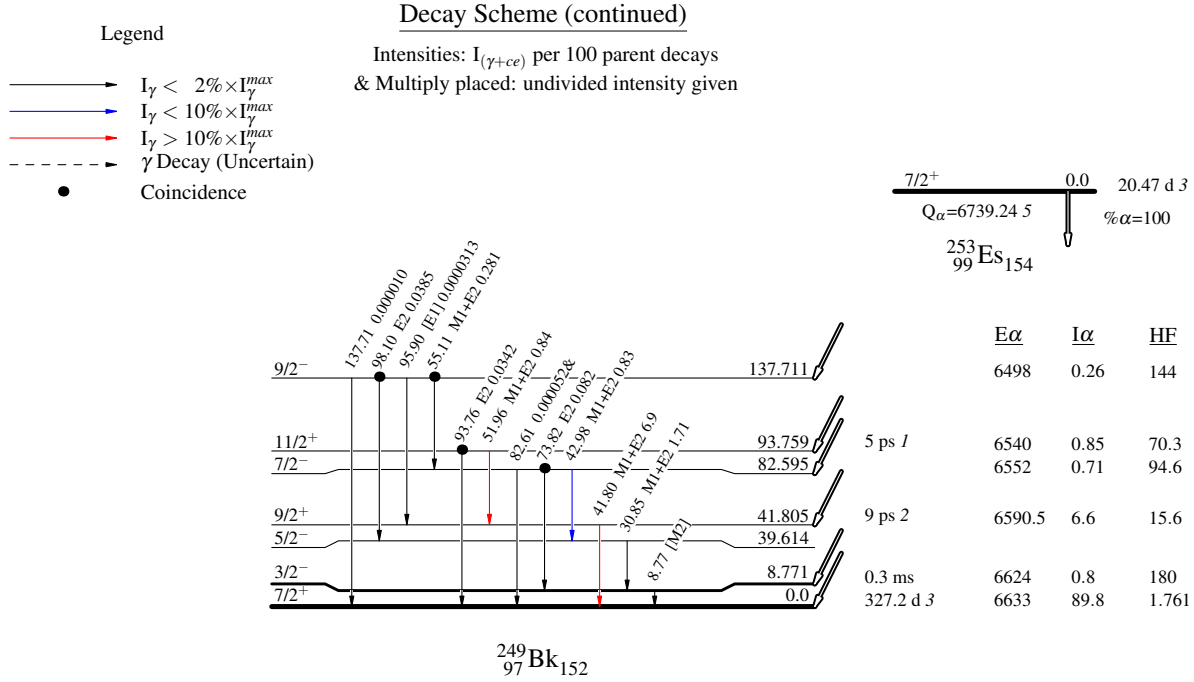


$^{249}_{97}Bk_{152}$

^{253}Es α decay (20.47 d) 2005Ah03,1975Ah01

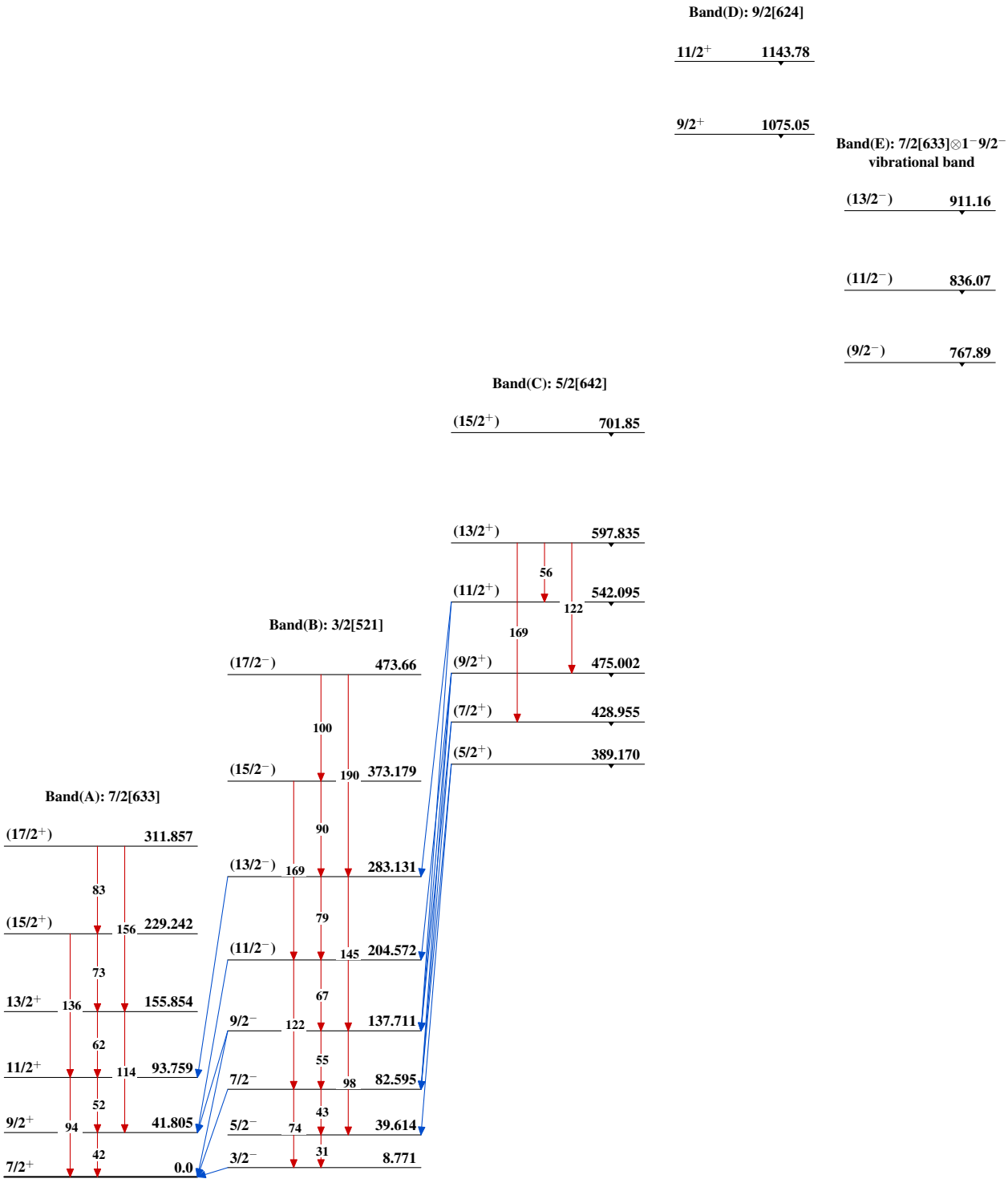
Decay Scheme (continued)

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



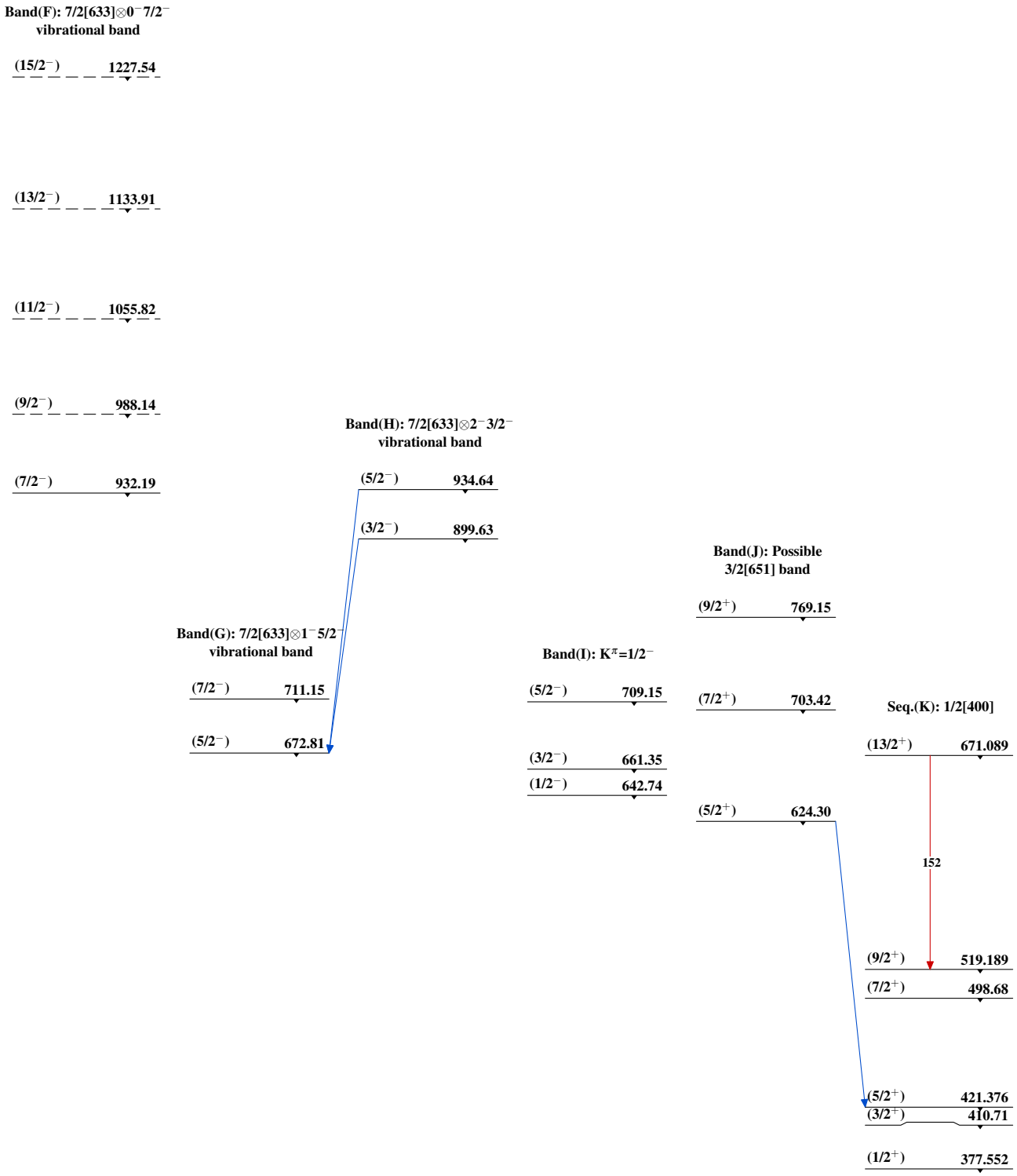
	Eα	Iα	HF
	6498	0.26	144
	6540	0.85	70.3
	6552	0.71	94.6
	6590.5	6.6	15.6
	6624	0.8	180
	6633	89.8	1.761

^{253}Es α decay (20.47 d) 2005Ah03,1975Ah01



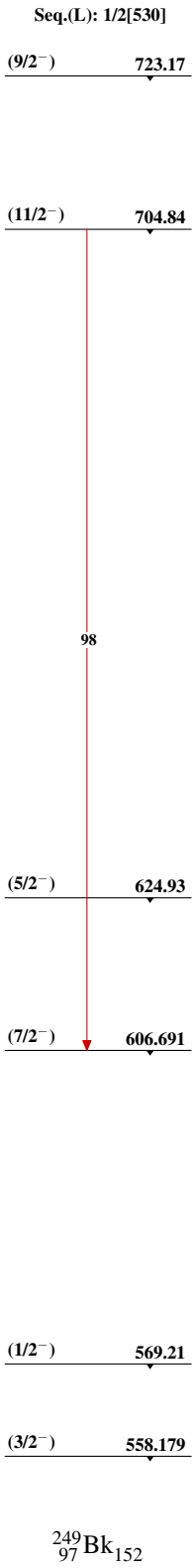
$^{249}_{97}Bk_{152}$

^{253}Es α decay (20.47 d) 2005Ah03,1975Ah01 (continued)



$^{249}_{97}Bk_{152}$

^{253}Es α decay (20.47 d) 2005Ah03,1975Ah01 (continued)



$^{249}_{97}Bk_{152}$