

Adopted Levels, Gammas

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	Ictp-2014 Workshop Group		NDS 132, 257 (2016)	15-Jan-2016

Q(β^-)=-1026 7; S(n)=5462 5; S(p)=5793 3; Q(α)=6146.60 10 2012Wa38
 S(2n)=12647 6, S(2p)=10766 3 (2012Wa38).

²²⁷Th evaluated by E.A. McCutchan, K. Abusaleem, S. Bhattacharya, P.K. Joshi and S.S. Nafee.

²²⁷Th Levels

Cross Reference (XREF) Flags

- A ²²⁷Ac β^- decay (21.772 y)
- B ²²⁷Pa ϵ decay (38.3 min)
- C ²³¹U α decay (4.2 d)
- D ²²⁶Ra($\alpha,3\gamma$)

E(level) [†]	J ^{π}	T _{1/2}	XREF	Comments
0.0 [‡]	(1/2 ⁺)	18.697 d 7	ABC	% α =100 Evaluated rms charge radius=5.740 fm 17 (2013An02). T _{1/2} : recommended by 2015Co11 from their measurements of 18.695 d 4 (decay-curves of 50.1 γ , 236.0 γ and 300.0 γ emissions) and 18.683 d 20 (from in-growth of ²²³ Ra using an ionization chamber); and 18.7176 d 180 (1967JoZX, original uncertainty of 0.0052 inflated to 0.0180 by 2015Co11). Power-moderated averaging proposed by S. Pomme and J. Keightley, Metrologia 52, S200 (2015) was used by 2015Co11 to deduce the recommended value. Others: 18.738 d 54 (1987Mi10), 18.729 d 48 (1963Ei10), 18.169 d 84 (1954Ha60), 18.6 d 1 (1949Pe08). The value from 1987Mi10 is omitted in the averaging procedure by 2015Co11, since correction for the presence of ²²³ Ac was not accounted for in their measurement. Values in 1963Ei10 and 1954Ha60 are superseded by that in 1967JoZX. J ^{π} : $\alpha\gamma(\theta)$ results from various authors are in disagreement: α -79 $\gamma(\theta)$ and α -350 $\gamma(\theta)$ suggest J ^{π} =1/2 ⁺ (1991Jo05). This conclusion is consistent with the isotropic correlation results of 1990Br23 and 1960Pe13 for α -236 $\gamma(\theta)$, also suggesting J ^{π} =1/2 ⁺ . 1972He18 measured an anisotropic correlation, and 1990Br23 measured γ -ray anisotropy in α 236 $\gamma(\theta,H)$ correlation with oriented nuclei. Both of these results suggest J ^{π} =3/2 ⁺ . In a nuclear orientation experiment with ²²⁷ Th at low temperature, 1997Mu08 found the angular distribution of the three main α groups from ²²⁷ Th to be isotropic. This result suggests J=1/2 for ²²⁷ Th g.s. Also, they suggested to be in error previous experiments that showed γ -ray anisotropies. Low α hindrance factor (HF=5.9) to 286 level (J ^{π} =1/2 ⁺) in ²²³ Ra is consistent with J ^{π} =1/2 ⁺ ,3/2. ²²⁵ Ra isotone ground state has J ^{π} =1/2 ⁺ . The same assignment for ²²⁷ Th is consistent with band structure in this nucleus and has been suggested by 1988Le13.
9.30 [‡] 3	(5/2 ⁺)		ABCD	J ^{π} : (E2) 9.3 γ to (1/2 ⁺).
24.38 3	(3/2 ⁺)		ABC	J ^{π} : M1+E2 24.3 γ to (1/2 ⁺).
37.863& 25	(3/2 ⁻)		ABCD	J ^{π} : E1 37.9 γ to (1/2 ⁺), E1 28.6 γ to (5/2 ⁺).
73.67& 4	(7/2 ⁻)		CD	J ^{π} : E1 64.4 γ to (5/2 ⁺); band assignment.
76.23 [‡] 4	(9/2 ⁺)		CD	J ^{π} : E2 66.9 γ to (5/2 ⁺).
77.63# 3	(3/2 ⁺)		BCD	J ^{π} : E1 39.9 γ to (3/2 ⁻), M1(+E2) 68.3 γ to (5/2 ⁺).
86.82? 7			C	

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Adopted Levels, Gammas (continued) ^{227}Th Levels (continued)

E(level) [†]	J ^π	XREF	Comments
99.18 3	(3/2 ⁺ ,5/2 ⁺)	BCD	J ^π : E1 61.3γ to 3/2 ⁻ , 105γ from (7/2 ⁺).
127.30 4	(3/2 ⁺ ,5/2 ⁺)	BC	J ^π : M1 102.9γ to (3/2 ⁺), M1 118γ to (5/2 ⁺).
149.99 [@] 18	(5/2 ⁻)	D	J ^π : 72.2γ to (3/2 ⁺), 76.5γ to (7/2 ⁻); band assignment.
182.2 [‡] 3	(13/2 ⁺)	D	J ^π : E2 106γ to (9/2 ⁺); band assignment.
183.71 4	(1/2 ⁻ ,3/2 ⁻ ,5/2 ⁻)	BC	J ^π : E1 56.4γ to (3/2 ⁺ ,5/2 ⁺), 159.4γ to (3/2 ⁺).
200.02 7	(⁻)	C	J ^π : E1 72.8γ to (3/2 ⁺ ,5/2 ⁺).
204.27 [#] 18	(7/2 ⁺)	D	J ^π : 126.5γ to (3/2 ⁺); band assignment.
207.13 10	(1/2 ⁻ ,3/2 ⁻ ,5/2 ⁻)	B	J ^π : (E1) 129.5γ to (3/2 ⁺).
228.60 7	(3/2 ⁻ ,5/2 ⁻)	BC	J ^π : E1 204.2γ to (3/2 ⁺), E1 219.6γ to (5/2 ⁺).
231.46 9	(5/2 ⁻ ,7/2 ⁻ ,9/2 ⁻)	C	J ^π : (M1) 157.8γ to (7/2 ⁻).
269.08 [@] 24	(9/2 ⁻)	D	J ^π : E2 119γ to (5/2 ⁻); band assignment.
289.04 3	(1/2 ⁺ ,3/2 ⁺ ,5/2 ⁺)	C	J ^π : M1 264.7γ to (3/2 ⁺).
318.96 7	(5/2 ⁺ ,7/2 ⁺)	C	J ^π : M1 309.7γ to (5/2 ⁺), 242.7γ to (9/2 ⁺).
344.2 [‡] 4	(17/2 ⁺)	D	J ^π : E2 162γ to (13/2 ⁺); band assignment.
372.8 ^{&} 6	(15/2 ⁻)	D	J ^π : E1 191γ to (13/2 ⁺); band assignment.
383.0 [#] 3	(11/2 ⁺)	D	J ^π : E1 113.9γ to (9/2 ⁻), 178.7γ to (7/2 ⁺); band assignment.
400.14 20		C	
438.5 [@] 3	(13/2 ⁻)	D	J ^π : E2 169.4γ to (9/2 ⁻); band assignment.
448.14 18		B	
503.36 19		B	
547.02 15		B	A 294.6-keV γ ray, reported from ^{227}Pa ε decay, feeds a 252.4-keV level that was not adopted.
553.6 ^{&} 6	(19/2 ⁻)	D	J ^π : E1 209γ to (17/2 ⁺); band assignment.
559.9 [‡] 5	(21/2 ⁺)	D	J ^π : 216γ to (17/2 ⁺); band assignment.
607.7 [#] 3	(15/2 ⁺)	D	J ^π : E1 169γ to (13/2 ⁻), E2 225γ to (11/2 ⁺); band assignment.
616.7 ^a 4		D	
662.2 [@] 4	(17/2 ⁻)	D	J ^π : 223.7γ to (13/2 ⁻); band assignment.
688.70 15		B	
698.3 4		B	
778.1 ^{&} 6	(23/2 ⁻)	D	J ^π : 224.5γ to (19/2 ⁻); band assignment.
823.6 [‡] 6	(25/2 ⁺)	D	J ^π : 263.7γ to (21/2 ⁺); band assignment.
870.3 ^a 4		D	
873.4 [#] 4	(19/2 ⁺)	D	J ^π : E1 211γ to (17/2 ⁻), 265.7γ to (15/2 ⁺); band assignment.
937.2 [@] 5	(21/2 ⁻)	D	J ^π : 275γ to (17/2 ⁻); band assignment.
1046.6 ^{&} 6	(27/2 ⁻)	D	J ^π : 268.5γ to (23/2 ⁻); band assignment.
1123.8 ^b 7		D	
1129.6 [‡] 6	(29/2 ⁺)	D	J ^π : 306γ to (25/2 ⁺); band assignment.
1167.9 ^a 5		D	
1177.0 [#] 5	(23/2 ⁺)	D	J ^π : E1 240γ to (21/2 ⁻), 304γ to (19/2 ⁺); band assignment.
1258.2 [@] 5	(25/2 ⁻)	D	J ^π : 321γ to (21/2 ⁻); band assignment.
1357.9 ^{&} 7	(31/2 ⁻)	D	J ^π : 311γ to (27/2 ⁻); band assignment.
1437.6 ^b 7		D	
1472.3 [‡] 7	(33/2 ⁺)	D	J ^π : 343γ to (29/2 ⁺); band assignment.
1502.3 ^a 5		D	
1515.6 [#] 6	(27/2 ⁺)	D	J ^π : 339γ to (23/2 ⁺); band assignment.
1618.8 [@] 7	(29/2 ⁻)	D	J ^π : 360.6γ to (25/2 ⁻); band assignment.
1708.7 ^{&} 8	(35/2 ⁻)	D	J ^π : 351γ to (31/2 ⁻); band assignment.
1782.2 ^b 7		D	

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Adopted Levels, Gammas (continued) ^{227}Th Levels (continued)

E(level) [†]	J ^π	XREF	Comments
1845.8 [‡] 8	(37/2 ⁺)	D	J ^π : 373.5γ to (33/2 ⁺); band assignment.
1867.1 ^a 6		D	
1887.2 [#] 7	(31/2 ⁺)	D	J ^π : 371.6γ to (27/2 ⁺); band assignment.
2013.3 [@] 9	(33/2 ⁻)	D	J ^π : 394.5γ to (29/2 ⁻); band assignment.
2094.5 ^{&} 8	(39/2 ⁻)	D	J ^π : 385γ to (35/2 ⁻); band assignment.
2242.5 [‡] 10	(41/2 ⁺)	D	J ^π : 398γ to (37/2 ⁺); band assignment.
2288.9 [#] 9	(35/2 ⁺)	D	J ^π : 402γ to (31/2 ⁺); band assignment.
2436.8 [@] 10	(37/2 ⁻)	D	J ^π : 423.5γ to (33/2 ⁻); band assignment.
2655.1 [‡] 11	(45/2 ⁺)	D	J ^π : 413γ to (41/2 ⁺); band assignment.

[†] From a least-squares fit to Eγ, by evaluators.

[‡] Band(A): K^π=1/2⁺ band, α=+1/2.

[#] Band(B): K^π=1/2⁺ band, α=-1/2.

[@] Band(C): K^π=1/2⁻ band, α=+1/2.

[&] Band(D): K^π=1/2⁻ band, α=-1/2.

^a Band(E): rotational band sequence. Proposed as a K^π=3/2⁻ band by [2002Ha30](#).

^b Band(F): rotational band sequence.

Adopted Levels, Gammas (continued)

E _i (level)	J _i ^π	E _γ [†]	I _γ [†]	E _f	J _f ^π	Mult. [‡]	γ(²²⁷ Th)		α ^d	Comments
							δ [‡]			
9.30	(5/2 ⁺)	9.3 ^a 1	100 ^a	0.0	(1/2 ⁺)	(E2) ^b			3.26×10 ⁵ 19	α(M)=2.44×10 ⁵ 14; α(N)=6.5×10 ⁴ 4; α(O)=1.44×10 ⁴ 9; α(P)=2.37×10 ³ 14; α(Q)=2.85 15
24.38	(3/2 ⁺)	15.1 ^a 2	2.2 ^a	9.30	(5/2 ⁺)	(M1) ^b			242 11	α(M)=180 8; α(N)=48.2 21; α(O)=11.4 5; α(P)=2.21 10; α(Q)=0.212 9
		24.33 [#] 5	100 ^a 20	0.0	(1/2 ⁺)	M1+E2 ^b	0.097 ^b 5		334 12	α(L)=250 9; α(M)=62.8 23; α(N)=16.8 6; α(O)=3.89 14; α(P)=0.721 23; α(Q)=0.0512 8
37.863	(3/2 ⁻)	28.57 [#] 5	96 [#] 19	9.30	(5/2 ⁺)	E1 ^{&}			3.23	α(L)=2.42 4; α(M)=0.616 9; α(N)=0.1595 24; α(O)=0.0341 5; α(P)=0.00517 8 α(Q)=0.000182 3
		37.90 [#] 3	100 [#] 19	0.0	(1/2 ⁺)	E1 ^{&}			1.537	α(L)=1.155 17; α(M)=0.288 4; α(N)=0.0750 11; α(O)=0.01634 24; α(P)=0.00260 4 α(Q)=0.0001035 15
73.67	(7/2 ⁻)	35.7 ^f		37.863	(3/2 ⁻)					
		64.38 [#] 2	#	9.30	(5/2 ⁺)	E1			0.377	α(L)=0.284 4; α(M)=0.0696 10; α(N)=0.0182 3; α(O)=0.00407 6; α(P)=0.000692 10 α(Q)=3.42×10 ⁻⁵ 5
76.23	(9/2 ⁺)	51.85 ^{#f} 4	25 [#] 5	24.38	(3/2 ⁺)					E _γ : questionable placement as transition would require M3 or E4 multipolarities based on adopted J ^π .
		66.94 [#] 3	100 [#] 10	9.30	(5/2 ⁺)	E2 ^c			75.4	α(L)=55.1 8; α(M)=15.13 22; α(N)=4.05 6; α(O)=0.901 13; α(P)=0.1489 21; α(Q)=0.000466 7
77.63	(3/2 ⁺)	39.88 [#] 6	8 [#] 2	37.863	(3/2 ⁻)	E1			1.343	α(L)=1.010 15; α(M)=0.251 4; α(N)=0.0654 10; α(O)=0.01430 21; α(P)=0.00229 4 α(Q)=9.33×10 ⁻⁵ 14
		53.23 [#] 2	83 [#] 8	24.38	(3/2 ⁺)	M1(+E2)	≤0.33		34 10	α(L)=25 8; α(M)=6.4 21; α(N)=1.7 6; α(O)=0.39 12; α(P)=0.072 20; α(Q)=0.00488 20
		68.33 [#] 2	100 [#] 5	9.30	(5/2 ⁺)	M1(+E2)	≤0.50		17 6	α(L)=13 5; α(M)=3.2 12; α(N)=0.9 4; α(O)=0.20 7; α(P)=0.037 11; α(Q)=0.00224 21
86.82?		77.52 ^f 6	100	9.30	(5/2 ⁺)					
99.18	(3/2 ⁺ ,5/2 ⁺)	61.33 [#] 3	80 [#] 8	37.863	(3/2 ⁻)	E1			0.429	α(L)=0.323 5; α(M)=0.0792 12; α(N)=0.0207 3; α(O)=0.00463 7; α(P)=0.000782 11 α(Q)=3.79×10 ⁻⁵ 6
		74.85 [#] 5	48 [#] 8	24.38	(3/2 ⁺)					
		89.88 [#] 5	100 [#] 24	9.30	(5/2 ⁺)					
		99.09 [#] 8	26 [#] 6	0.0	(1/2 ⁺)					
127.30	(3/2 ⁺ ,5/2 ⁺)	102.93 [#] 4	100 [#] 10	24.38	(3/2 ⁺)	M1			3.49	α(L)=2.63 4; α(M)=0.634 9; α(N)=0.1691 24; α(O)=0.0400 6; α(P)=0.00777 11 α(Q)=0.000739 11

Adopted Levels, Gammas (continued)

$\gamma(^{227}\text{Th})$ (continued)								
$E_i(\text{level})$	J_i^π	E_γ^\dagger	I_γ^\dagger	E_f	J_f^π	Mult. [‡]	α^d	Comments
127.30	(3/2 ⁺ ,5/2 ⁺)	117.98 [#] 7	44 [#] 9	9.30	(5/2 ⁺)	M1	11.58	$\alpha(\text{K})=9.23$ 13; $\alpha(\text{L})=1.78$ 3; $\alpha(\text{M})=0.427$ 6; $\alpha(\text{N})=0.1140$ 16; $\alpha(\text{O})=0.0270$ 4; $\alpha(\text{P})=0.00524$ 8 $\alpha(\text{Q})=0.000498$ 7
149.99	(5/2 ⁻)	72.2 3 76.5 3		77.63 (3/2 ⁺) 73.67 (7/2 ⁻)		(E2)	39.8 10	$\alpha(\text{L})=29.1$ 7; $\alpha(\text{M})=8.00$ 19; $\alpha(\text{N})=2.14$ 5; $\alpha(\text{O})=0.477$ 12; $\alpha(\text{P})=0.0789$ 19; $\alpha(\text{Q})=0.000271$ 6
182.2	(13/2 ⁺)	106.0 3	100	76.23 (9/2 ⁺)		E2 ^c	8.59 17	$\alpha(\text{L})=6.28$ 13; $\alpha(\text{M})=1.73$ 4; $\alpha(\text{N})=0.463$ 9; $\alpha(\text{O})=0.1031$ 20; $\alpha(\text{P})=0.0171$ 4; $\alpha(\text{Q})=8.07\times 10^{-5}$ 14
183.71	(1/2 ⁻ ,3/2 ⁻ ,5/2 ⁻)	56.41 [#] 2	100 [#] 10	127.30 (3/2 ⁺ ,5/2 ⁺)		E1	0.535	$\alpha(\text{L})=0.403$ 6; $\alpha(\text{M})=0.0991$ 14; $\alpha(\text{N})=0.0259$ 4; $\alpha(\text{O})=0.00576$ 8; $\alpha(\text{P})=0.000965$ 14 $\alpha(\text{Q})=4.53\times 10^{-5}$ 7
200.02	(-)	84.5 [@] 3	5.4 [@] 25	99.18 (3/2 ⁺ ,5/2 ⁺)				
		146.0 [@] 3	4.6 [@] 25	37.863 (3/2 ⁻)				
		159.39 [#] 8	26 [#] 5	24.38 (3/2 ⁺)				
		72.78 [#] 7	100 [#] 20	127.30 (3/2 ⁺ ,5/2 ⁺)	E1	0.272	$\alpha(\text{L})=0.205$ 3; $\alpha(\text{M})=0.0501$ 8; $\alpha(\text{N})=0.01314$ 19; $\alpha(\text{O})=0.00295$ 5; $\alpha(\text{P})=0.000508$ 8 $\alpha(\text{Q})=2.62\times 10^{-5}$ 4	
204.27	(7/2 ⁺)	190.62 [#] 10	61 [#] 14	9.30 (5/2 ⁺)				
		54.3 3		149.99 (5/2 ⁻)				
		105.2 3		99.18 (3/2 ⁺ ,5/2 ⁺)				
		126.5 3		77.63 (3/2 ⁺)				
207.13	(1/2 ⁻ ,3/2 ⁻ ,5/2 ⁻)	129.5 ^{e@} 1	100 ^{e@}	77.63 (3/2 ⁺)		(E1) ^{&}	0.266	$\alpha(\text{K})=0.206$ 3; $\alpha(\text{L})=0.0451$ 7; $\alpha(\text{M})=0.01092$ 16; $\alpha(\text{N})=0.00288$ 4; $\alpha(\text{O})=0.000658$ 10 $\alpha(\text{P})=0.0001180$ 17; $\alpha(\text{Q})=7.37\times 10^{-6}$ 11
228.60	(3/2 ⁻ ,5/2 ⁻)	129.5 ^{e@} 1	24 ^{e@} 3	99.18 (3/2 ⁺ ,5/2 ⁺)				
		150.7 [#] 2	98 [#] 50	77.63 (3/2 ⁺)	E1	0.185	$\alpha(\text{K})=0.1446$ 21; $\alpha(\text{L})=0.0305$ 5; $\alpha(\text{M})=0.00737$ 11; $\alpha(\text{N})=0.00194$ 3; $\alpha(\text{O})=0.000446$ 7 $\alpha(\text{P})=8.07\times 10^{-5}$ 12; $\alpha(\text{Q})=5.26\times 10^{-6}$ 8	
		190.8 [@] 2	8.0 [@] 24	37.863 (3/2 ⁻)				
231.46	(5/2 ⁻ ,7/2 ⁻ ,9/2 ⁻)	204.2 [#] 2	100 [#] 24	24.38 (3/2 ⁺)	E1	0.0899	$\alpha(\text{K})=0.0711$ 10; $\alpha(\text{L})=0.01416$ 21; $\alpha(\text{M})=0.00341$ 5; $\alpha(\text{N})=0.000901$ 13; $\alpha(\text{O})=0.000208$ 3 $\alpha(\text{P})=3.82\times 10^{-5}$ 6; $\alpha(\text{Q})=2.69\times 10^{-6}$ 4	
		219.6 [#] 4	66 [#] 24	9.30 (5/2 ⁺)	E1	0.0758	$\alpha(\text{K})=0.0602$ 9; $\alpha(\text{L})=0.01183$ 18; $\alpha(\text{M})=0.00285$ 5; $\alpha(\text{N})=0.000752$ 11; $\alpha(\text{O})=0.000174$ 3 $\alpha(\text{P})=3.21\times 10^{-5}$ 5; $\alpha(\text{Q})=2.30\times 10^{-6}$ 4	
		157.79 [#] 8	100 [#]	73.67 (7/2 ⁻)	(M1)	5.08	$\alpha(\text{K})=4.06$ 6; $\alpha(\text{L})=0.773$ 11; $\alpha(\text{M})=0.186$ 3; $\alpha(\text{N})=0.0496$ 7; $\alpha(\text{O})=0.01173$ 17 $\alpha(\text{P})=0.00228$ 4; $\alpha(\text{Q})=0.000216$ 3	
269.08	(9/2 ⁻)	64.8 3 119.1 3	69 10 100 15	204.27 (7/2 ⁺) 149.99 (5/2 ⁻)		E2 ^c	5.27 10	$\alpha(\text{K})=0.253$ 4; $\alpha(\text{L})=3.67$ 7; $\alpha(\text{M})=1.007$ 19; $\alpha(\text{N})=0.270$ 5;

Adopted Levels, Gammas (continued)

 $\gamma(^{227}\text{Th})$ (continued)

$E_i(\text{level})$	J_i^π	E_γ^\dagger	I_γ^\dagger	E_f	J_f^π	Mult. [‡]	α^d	Comments
								$\alpha(\text{O})=0.0602$ 11 $\alpha(\text{P})=0.01003$ 19; $\alpha(\text{Q})=5.46\times 10^{-5}$ 9
289.04	(1/2 ⁺ ,3/2 ⁺ ,5/2 ⁺)	60.6 [#] 2 189.9 [#] 3 211.4 [#] 2 264.66 [#] 3	3.6 [#] 11 6.0 [#] 20 14 [#] 3 100 [#] 8	228.60 99.18 77.63 24.38	(3/2 ⁻ ,5/2 ⁻) (3/2 ⁺ ,5/2 ⁺) (3/2 ⁺) (3/2 ⁺)	M1	1.191	$\alpha(\text{K})=0.953$ 14; $\alpha(\text{L})=0.180$ 3; $\alpha(\text{M})=0.0432$ 6; $\alpha(\text{N})=0.01152$ 17; $\alpha(\text{O})=0.00273$ 4 $\alpha(\text{P})=0.000529$ 8; $\alpha(\text{Q})=5.02\times 10^{-5}$ 7
318.96	(5/2 ⁺ ,7/2 ⁺)	279.76 [#] 5 289.01 [#] 6 241.2 ^{#f} 3 242.7 [#] 2 294.5 [#] 2 309.68 [#] 7	53 [#] 6 44 [#] 6 6 [#] 3 14 [#] 5 25 [#] 8 100 [#] 17	9.30 0.0 77.63 76.23 24.38 9.30	(5/2 ⁺) (1/2 ⁺) (3/2 ⁺) (9/2 ⁺) (3/2 ⁺) (5/2 ⁺)	M1	0.772	$\alpha(\text{K})=0.618$ 9; $\alpha(\text{L})=0.1162$ 17; $\alpha(\text{M})=0.0279$ 4; $\alpha(\text{N})=0.00744$ 11; $\alpha(\text{O})=0.001762$ 25 $\alpha(\text{P})=0.000342$ 5; $\alpha(\text{Q})=3.24\times 10^{-5}$ 5 $\alpha(\text{K})=0.221$ 4; $\alpha(\text{L})=0.916$ 15; $\alpha(\text{M})=0.251$ 4; $\alpha(\text{N})=0.0672$ 11; $\alpha(\text{O})=0.01503$ 25 $\alpha(\text{P})=0.00252$ 4; $\alpha(\text{Q})=2.16\times 10^{-5}$ 4
344.2	(17/2 ⁺)	162.0 3	100	182.2	(13/2 ⁺)	E2 ^c	1.472 24	$\alpha(\text{K})=0.0835$ 13; $\alpha(\text{L})=0.0168$ 3; $\alpha(\text{M})=0.00405$ 7; $\alpha(\text{N})=0.001070$ 17; $\alpha(\text{O})=0.000247$ 4 $\alpha(\text{P})=4.52\times 10^{-5}$ 7; $\alpha(\text{Q})=3.13\times 10^{-6}$ 5
372.8	(15/2 ⁻)	190.6 5	100	182.2	(13/2 ⁺)	E1 ^c	0.1057 17	$\alpha(\text{K})=0.275$ 5; $\alpha(\text{L})=0.0630$ 10; $\alpha(\text{M})=0.01528$ 24; $\alpha(\text{N})=0.00402$ 7; $\alpha(\text{O})=0.000917$ 15 $\alpha(\text{P})=0.000163$ 3; $\alpha(\text{Q})=9.81\times 10^{-6}$ 15
383.0	(11/2 ⁺)	113.9 3	100 15	269.08	(9/2 ⁻)	E1 ^c	0.358 6	
400.14		178.7 3 111.1 [#] 2	56 8 100 [#]	204.27 289.04	(7/2 ⁺) (1/2 ⁺ ,3/2 ⁺ ,5/2 ⁺)			
438.5	(13/2 ⁻)	55.6 5 169.4 3		383.0 269.08	(11/2 ⁺) (9/2 ⁻)	E2	1.235 20	$\alpha(\text{K})=0.207$ 3; $\alpha(\text{L})=0.752$ 12; $\alpha(\text{M})=0.206$ 4; $\alpha(\text{N})=0.0551$ 9; $\alpha(\text{O})=0.01234$ 20 $\alpha(\text{P})=0.00207$ 4; $\alpha(\text{Q})=1.91\times 10^{-5}$ 3
448.14		264.6 [@] 2 370.0 [@] 7 409.5 [@] 5	100 [@] 25 ≈ 10 [@] ≈ 13 [@]	183.71 77.63 37.863	(1/2 ⁻ ,3/2 ⁻ ,5/2 ⁻) (3/2 ⁺) (3/2 ⁻)			
503.36		319.6 [@] 3 404.1 [@] 5	100 [@] 27 22 [@] 11	183.71 99.18	(1/2 ⁻ ,3/2 ⁻ ,5/2 ⁻) (3/2 ⁺ ,5/2 ⁺)			
547.02		363.3 [@] 4 419.6 [@] 3	54 [@] 23 100 [@] 23	183.71 127.30	(1/2 ⁻ ,3/2 ⁻ ,5/2 ⁻) (3/2 ⁺ ,5/2 ⁺)			

Adopted Levels, Gammas (continued)

$\gamma(^{227}\text{Th})$ (continued)

$E_i(\text{level})$	J_i^π	E_γ †	I_γ †	E_f	J_f^π	Mult. ‡	α^d	Comments
547.02		522.8 @ 3	92 @ 31	24.38 (3/2 ⁺)				
		537.7 @ 7	31 @ 15	9.30 (5/2 ⁺)				
553.6	(19/2 ⁻)	209.4 5	100	344.2 (17/2 ⁺)		E1 ^c	0.0847 13	$\alpha(\text{K})=0.0671$ 11; $\alpha(\text{L})=0.01330$ 21; $\alpha(\text{M})=0.00320$ 5; $\alpha(\text{N})=0.000846$ 13; $\alpha(\text{O})=0.000195$ 3 $\alpha(\text{P})=3.59 \times 10^{-5}$ 6; $\alpha(\text{Q})=2.55 \times 10^{-6}$ 4
559.9	(21/2 ⁺)	215.7 3	100	344.2 (17/2 ⁺)				
607.7	(15/2 ⁺)	169.2 3	100 30	438.5 (13/2 ⁻)		E1	0.1403	$\alpha(\text{K})=0.1103$ 17; $\alpha(\text{L})=0.0227$ 4; $\alpha(\text{M})=0.00548$ 8; $\alpha(\text{N})=0.001446$ 22; $\alpha(\text{O})=0.000333$ 5 $\alpha(\text{P})=6.06 \times 10^{-5}$ 9; $\alpha(\text{Q})=4.07 \times 10^{-6}$ 6
		224.7 3	59 15	383.0 (11/2 ⁺)		E2	0.434	$\alpha(\text{K})=0.1280$ 19; $\alpha(\text{L})=0.225$ 4; $\alpha(\text{M})=0.0610$ 10; $\alpha(\text{N})=0.01634$ 25; $\alpha(\text{O})=0.00367$ 6 $\alpha(\text{P})=0.000623$ 10; $\alpha(\text{Q})=9.11 \times 10^{-6}$ 14
616.7		233.7 3	100	383.0 (11/2 ⁺)				
662.2	(17/2 ⁻)	54.5 5		607.7 (15/2 ⁺)				
		223.7 3		438.5 (13/2 ⁻)				
688.70		141.7 @ 2	34 @ 8	547.02				
		185.3 @ 2	63 @ 16	503.36				
		460.2 @ 4	47 @ 13	228.60 (3/2 ⁻ ,5/2 ⁻)				
		561.4 @ 3	100 @ 16	127.30 (3/2 ⁺ ,5/2 ⁺)				
		589.5 @ 4	37 @ 11	99.18 (3/2 ⁺ ,5/2 ⁺)				
698.3		469.7 4	100	228.60 (3/2 ⁻ ,5/2 ⁻)				
778.1	(23/2 ⁻)	218.2 5		559.9 (21/2 ⁺)				
		224.5 5		553.6 (19/2 ⁻)				
823.6	(25/2 ⁺)	263.7 3	100	559.9 (21/2 ⁺)				
870.3		253.6 5	51 10	616.7				
		262.6 5	100 20	607.7 (15/2 ⁺)				
873.4	(19/2 ⁺)	211.2 3	100 15	662.2 (17/2 ⁻)		E1 ^c	0.0830	$\alpha(\text{K})=0.0658$ 10; $\alpha(\text{L})=0.01302$ 19; $\alpha(\text{M})=0.00313$ 5; $\alpha(\text{N})=0.000828$ 12; $\alpha(\text{O})=0.000191$ 3 $\alpha(\text{P})=3.52 \times 10^{-5}$ 5; $\alpha(\text{Q})=2.50 \times 10^{-6}$ 4
		265.7 5	55 11	607.7 (15/2 ⁺)				
937.2	(21/2 ⁻)	275.0 3	100	662.2 (17/2 ⁻)				
1046.6	(27/2 ⁻)	223.0 5	79 14	823.6 (25/2 ⁺)				
		268.5 5	100 21	778.1 (23/2 ⁻)				
1123.8		253.5 5	100	870.3				
1129.6	(29/2 ⁺)	306.0 3	100	823.6 (25/2 ⁺)				
1167.9		(294.5 5)	100 20	873.4 (19/2 ⁺)				
		297.6 5	48 9	870.3				
1177.0	(23/2 ⁺)	239.8 5	100 20	937.2 (21/2 ⁻)		E1	0.0618 10	$\alpha(\text{K})=0.0492$ 8; $\alpha(\text{L})=0.00954$ 15; $\alpha(\text{M})=0.00229$ 4; $\alpha(\text{N})=0.000606$ 9; $\alpha(\text{O})=0.0001404$ 21 $\alpha(\text{P})=2.60 \times 10^{-5}$ 4; $\alpha(\text{Q})=1.90 \times 10^{-6}$ 3
		303.7 5	68 14	873.4 (19/2 ⁺)				

Adopted Levels, Gammas (continued)

$\gamma(^{227}\text{Th})$ (continued)

$E_i(\text{level})$	J_i^π	E_γ^\dagger	I_γ^\dagger	E_f	J_f^π	$E_i(\text{level})$	J_i^π	E_γ^\dagger	I_γ^\dagger	E_f	J_f^π
1258.2	(25/2 ⁻)	321.0 3	100	937.2	(21/2 ⁻)	1782.2		279.9 5	100	1502.3	
1357.9	(31/2 ⁻)	228.3 5	46 8	1129.6	(29/2 ⁺)	1845.8	(37/2 ⁺)	373.5 5	100	1472.3	(33/2 ⁺)
		311.3 5	100 23	1046.6	(27/2 ⁻)	1867.1		351.5 5		1515.6	(27/2 ⁺)
1437.6		269.7 5	100	1167.9				364.9 5		1502.3	
1472.3	(33/2 ⁺)	342.7 5	100	1129.6	(29/2 ⁺)	1887.2	(31/2 ⁺)	371.6 5	100	1515.6	(27/2 ⁺)
1502.3		325.2 5	82 18	1177.0	(23/2 ⁺)	2013.3	(33/2 ⁻)	394.5 5	100	1618.8	(29/2 ⁻)
		334.4 5	100 18	1167.9		2094.5	(39/2 ⁻)	248.7 5		1845.8	(37/2 ⁺)
1515.6	(27/2 ⁺)	257.4 5	100 20	1258.2	(25/2 ⁻)			385.8 5		1708.7	(35/2 ⁻)
		338.6 5	47 10	1177.0	(23/2 ⁺)	2242.5	(41/2 ⁺)	396.7 5	100	1845.8	(37/2 ⁺)
1618.8	(29/2 ⁻)	360.6 5	100	1258.2	(25/2 ⁻)	2288.9?	(35/2 ⁺)	401.7 ^f 5	100	1887.2	(31/2 ⁺)
1708.7	(35/2 ⁻)	(236.4 5)		1472.3	(33/2 ⁺)	2436.8	(37/2 ⁻)	423.5 5	100	2013.3	(33/2 ⁻)
		350.8 5		1357.9	(31/2 ⁻)	2655.1	(45/2 ⁺)	412.6 5	100	2242.5	(41/2 ⁺)

[†] From ²²⁶Ra($\alpha,3n\gamma$), except where noted.

[‡] From ²³¹U α decay, except where noted.

From ²³¹U α decay.

@ From ²²⁷Pa ϵ decay.

& From conversion electron measurements in ²²⁷Pa ϵ decay.

^a From ²²⁷Ac β^- decay.

^b From ce ratios in ²²⁷Ac β^- decay.

^c From conversion electron measurements in ²²⁶Ra($\alpha,3n\gamma$).

^d From BrIcc v2.3 (29-Mar-2013) [2008Ki07](#), "Frozen Orbitals" appr.

^e Multiply placed with undivided intensity.

^f Placement of transition in the level scheme is uncertain.

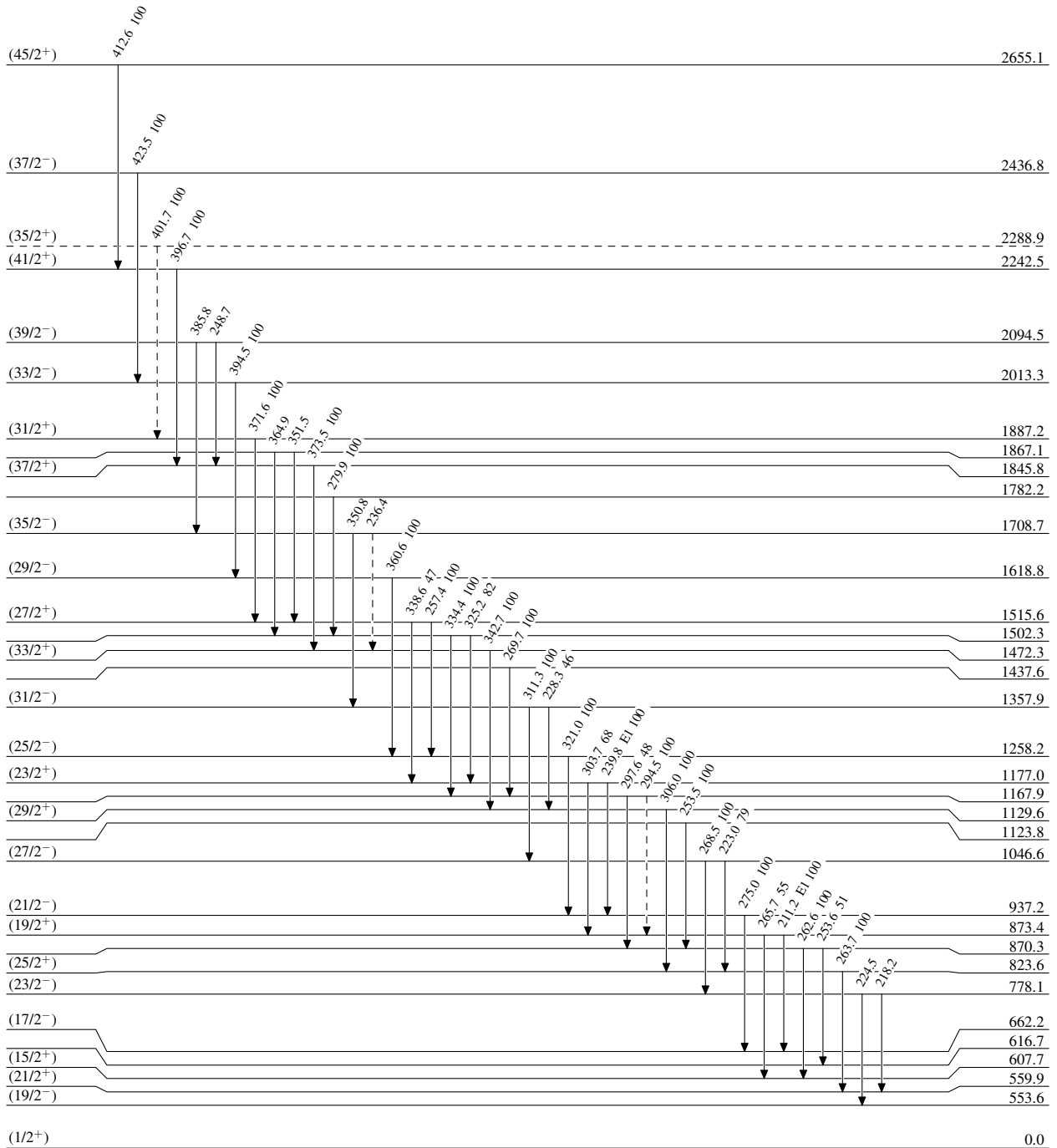
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

-----> γ Decay (Uncertain)



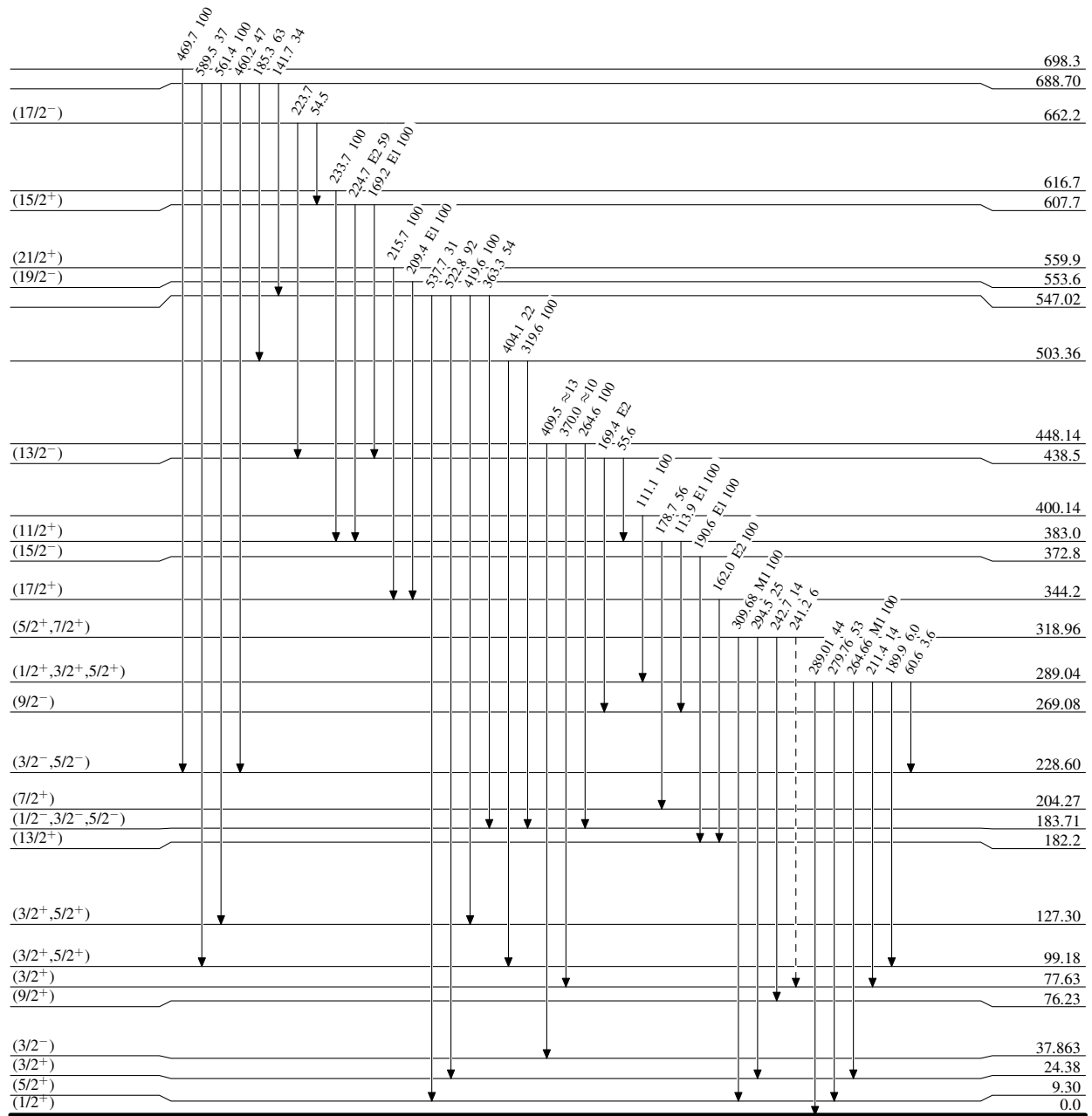
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

-----▶ γ Decay (Uncertain)



18.697 d 7

²²⁷Th₁₃₇

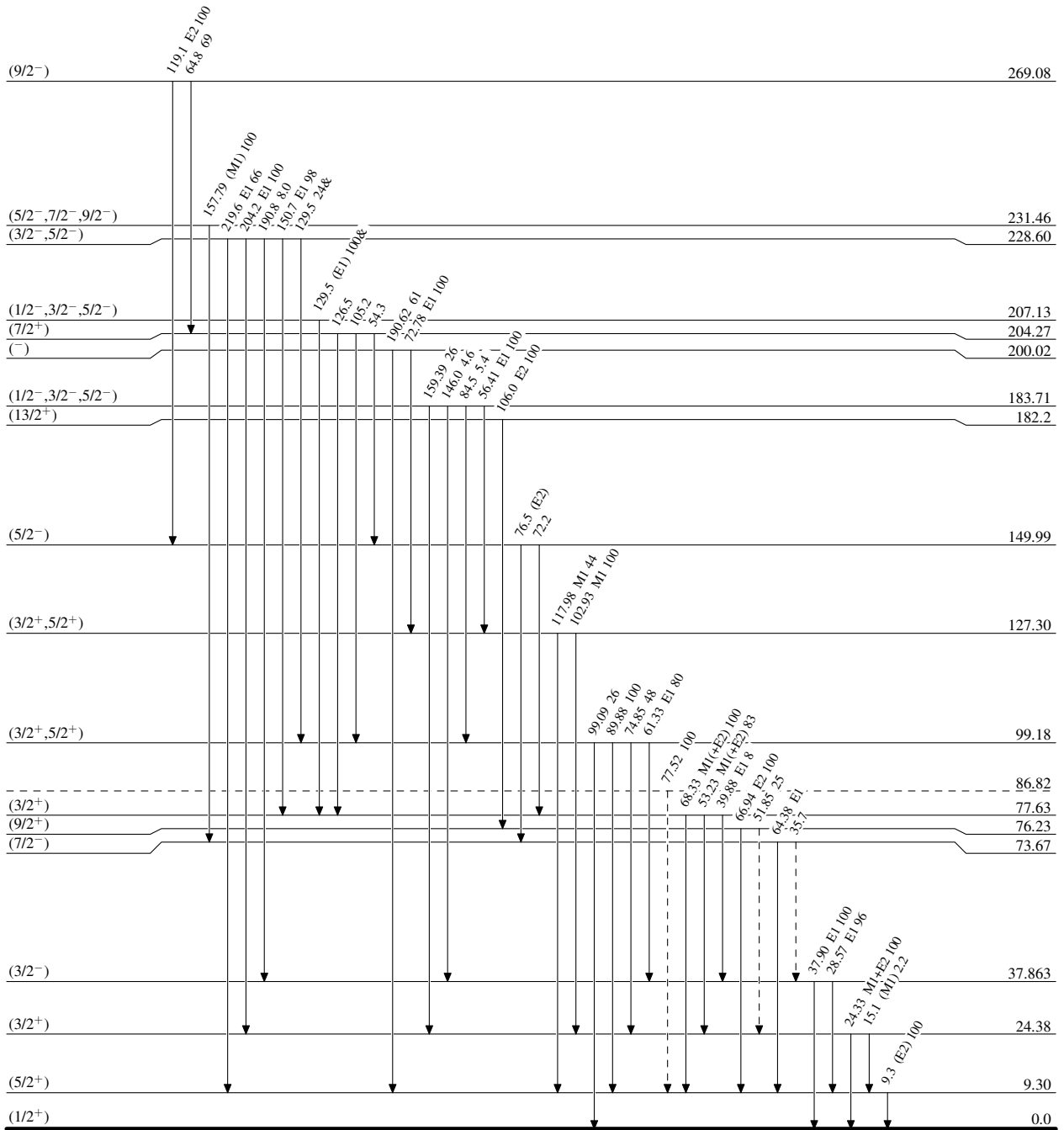
Adopted Levels, Gammas

Legend

Level Scheme (continued)

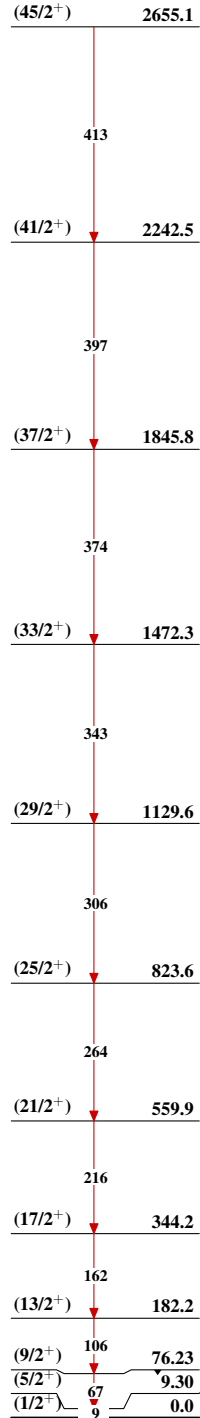
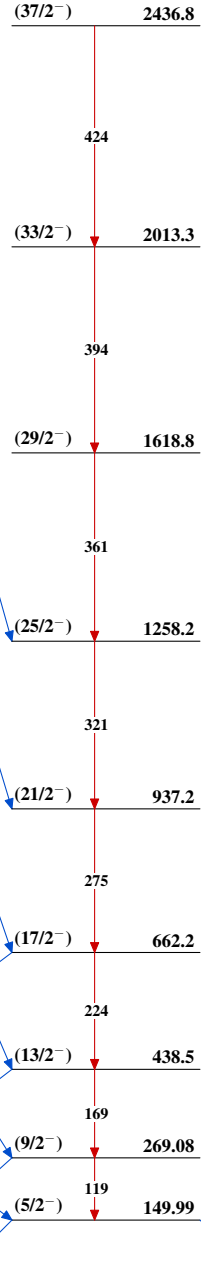
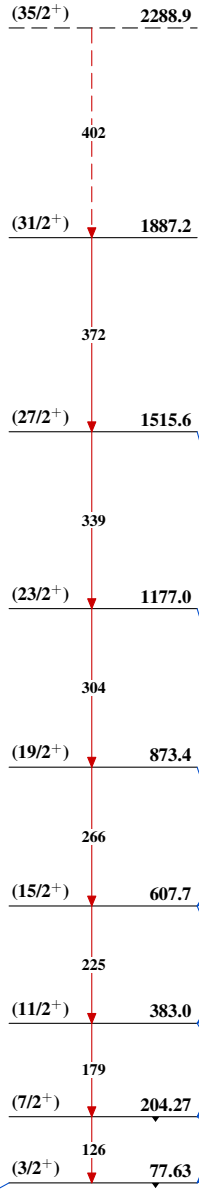
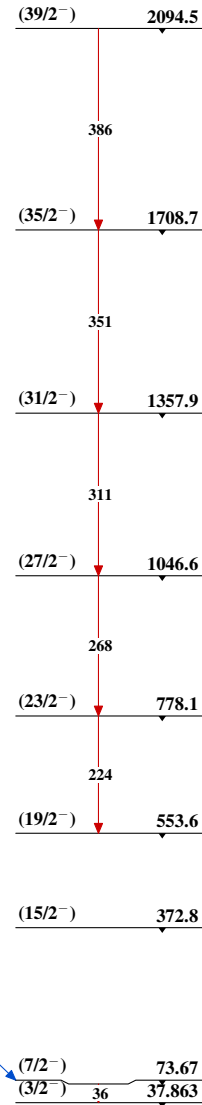
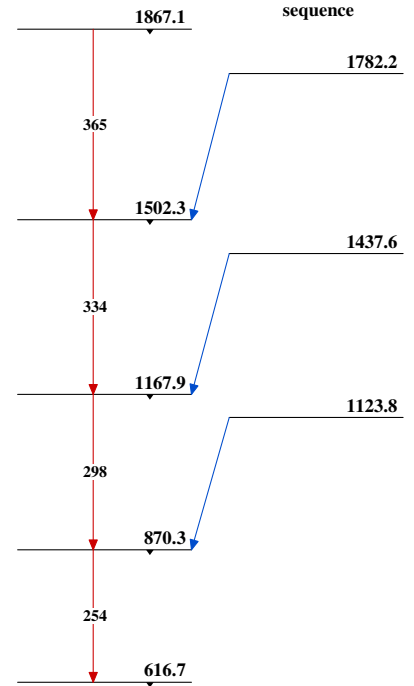
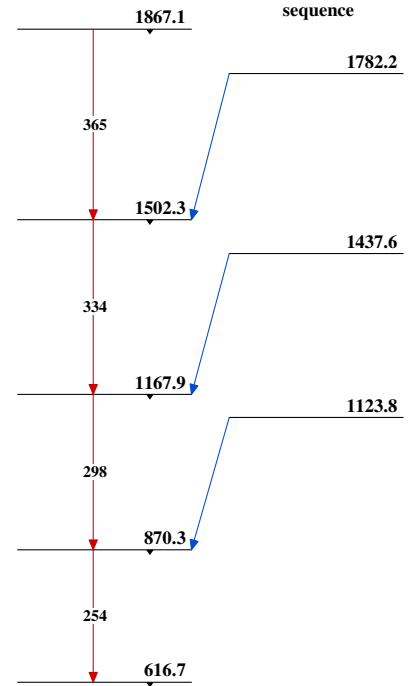
Intensities: Relative photon branching from each level
& Multiplied: undivided intensity given

-----► γ Decay (Uncertain)



18.697 d 7

$^{227}_{90}\text{Th}_{137}$

Adopted Levels, Gammas**Band(A): $K^\pi=1/2^+$ band,
 $\alpha=+1/2$** **Band(C): $K^\pi=1/2^-$ band,
 $\alpha=+1/2$** **Band(B): $K^\pi=1/2^+$ band,
 $\alpha=-1/2$** **Band(D): $K^\pi=1/2^-$ band,
 $\alpha=-1/2$** **Band(E): Rotational band
sequence****Band(F): Rotational band
sequence** $^{227}_{90}\text{Th}_{137}$