^{135}Ba(n,γ) E=thermal 1990Is07,1983BrZK,1969Ge07

History			
Type	Author	Citation	Literature Cutoff Date
Full Evaluation	E. A. Mccutchan	NDS 152, 331 (2018)	1-Apr-2018

Target $J^\pi=3/2^+$.
1990Is07: Measured Eγ, Iγ using a pair spectrometer consisting of a HPGe detector surrounded by a NaI(Tl) annulus.
1983BrZK: Measured Eγ, Iγ, $\gamma(\theta)$, $\gamma\gamma$ using two Ge(Li) detectors. γ-ray energy uncertainties and intensities were not reported.
1980GeZU: Measured Eγ, Iγ, Ece, Ice using curved crystal spectrometer with a Ge(Li) detector and a β spectrometer.
1969Ge07: Measured Eγ, Iγ, $\gamma\gamma$ using a Ge(Li) detector and NaI(Tl) detector.
1969Ge07, 1980GeZU and 1983BrZK are studies from same group.
Others: 1972Br53, 1978Bo41.

^{136}Ba Levels

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$	Comments
0.0	0^+		
818.54 *5*	2^+		E(level): other: 818.941 *6* (1980GeZU).
1551.01 *6*	2^+		E(level): other: 1551.760 *17* (1980GeZU).
1578.57 *16*	0^+		E(level): other: 1579.819 *14* (1980GeZU).
1866.8 *6*	4^+		E(level): other: 1867.560 *12* (1980GeZU).
2030.7 *9*	7^-	308.4[#] ms *19*	
2053.78 *23*	4^+		E(level): other: 2054.940 *15* (1980GeZU).
2080.00 *4*	2^+		E(level): other: 2081.150 *31* (1980GeZU).
2128.83 *5*	2^+		E(level): other: 2129.989 *57* (1980GeZU).
2140.93 *18*	5^-		
2141.37 *6*	0^+		E(level): other: 2141.353 *12* (1980GeZU).
2153.55 *8*			
2207.4 *6*	6^+		
2222.44 *10*	$(2)^+$		E(level): other: 2223.863 *8* (1980GeZU).
2299.3 *11*	(6^-)		
2315.38 *23*	0^+		
2355.1 *6*	4^+		E(level): other: 2357.681 *14* (1980GeZU).
2390.59 *23*	3^-		
2399.98 *6*	$(1^+,2^+)$		E(level): other: 2401.152 *30* (1980GeZU).
2430.47 *16*	3^+		E(level): other: 2432.092 *15* (1980GeZU).
2485.27 *7*	2^+		
2532.54 *7*	3^-		E(level): other: 2534.038 (1980GeZU).
2640.74 *12*	(1^+)		
2661.36 *9*	$1,2^+$		
2693.53 *10*	1		
2773.51 *6*	2^+		
2811.72 *12*	(3^+)		
2995.34 *18*			
3021.44 *11*	$(1,2^+)$		
3044.90 *4*	$1^{(-)}$		
3116.19 *17*	2^+		
3370.8 *3*	1		
3435.57 *6*	1^-		
3506.21 *18*	$0^{(+)},1,2,3^+$		
3691.93 *14*	1 to 3		
3767.41 *10*	$1^{(-)},2,3^+$		
3794.88 *5*	$(1,2^+)$		
3863.47 *23*	$(1,2^+)$		
3925.45 *25*			
3965.51 *5*	$(1,2^+)$		
3980.36 *8*	(1)		

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^{135}Ba(n,γ) E=thermal 1990Is07,1983BrZK,1969Ge07 (continued)

^{136}Ba Levels (continued)

E(level)[†]	Jπ[‡]	Comments
3992.58 *20*	$0^{(+)},1,2,3^+$	
4008.2 *4*	$1,2^+$	
4137.36 *8*	1	
(9107.74 *4*)	2[@]	E(level): from 2012Wa38. Other: 9107.84 *4* (1990Is07).

[†] From a least-squares fit to Eγ, by evaluator, except where noted. 1980GeZU provide precise level energies presumably from curved-crystal measurements, however, the authors state that the analysis is only partially complete and so these values are provided in the comments.
[‡] From the Adopted Levels.
[#] From γ(t) in 1972Br53.
[@] From γ-ray circular polarization (1978Bo41).

γ(^{136}Ba)

α(K)exp,ce(K): from 1980GeZU. α(K)exp were obtained by assuming that the 819γ is pure E2. Iγ(819γ)=33352, ce(K)(819γ)=1254.3. 1980GeZU normalized to α(K)≈0.0025 for 819γ; evaluator has renormalized to α(K)=0.0028.

Eγ[†]	Iγ[‡e]	Ei(level)	J_i^π	Ef	J_f^π	Mult.[#]	Comments
66.9		2207.4	6^+	2140.93	5^-		
86.4		2140.93	5^-	2053.78	4^+		
153.2		2207.4	6^+	2053.78	4^+		
157.8[&bf] *5*	22 *4*	3925.45		3767.41	$1^{(-)},2,3^+$		
158.4[&f]		2299.3	(6^-)	2140.93	5^-		
163.9		2030.7	7^-	1866.8	4^+		
176.7		2207.4	6^+	2030.7	7^-		
187.4		2053.78	4^+	1866.8	4^+		
273.7		2140.93	5^-	1866.8	4^+		
340.6		2207.4	6^+	1866.8	4^+		
671.3[af] *3*	14.7 *25*	2222.44	$(2)^+$	1551.01	2^+		
[x]721[b]							
732.6	79 *13*	1551.01	2^+	818.54	2^+	E2	α(K)exp=0.0034 *6*
747.3[a] *3*	14 *5*	3767.41	$1^{(-)},2,3^+$	3021.44	$(1,2^+)$		
760.7	17 *4*	1578.57	0^+	818.54	2^+	E2	α(K)exp=0.0036 *8*
818.7	815 *13*	818.54	2^+	0.0	0^+	[E2]	α(K): 1980GeZU apparently used α(K)≈0.0025.
880.3[a] *3*	4.9 *16*	3925.45		3044.90	$1^{(-)}$		
981.3[a] *6*	13 *4*	2532.54	3^-	1551.01	2^+	E1	α(K)exp≤0.00085
[x]1011.0 *8*							
1048.3	99 *11*	1866.8	4^+	818.54	2^+	D,Q	α(K)exp=0.00119 *19* Mult.: D,Q from α(K)exp, Q from Adopted ΔJ.
1234.9[a]	≤16.3	3767.41	$1^{(-)},2,3^+$	2532.54	3^-		
1235.6	52 *8*	2053.78	4^+	818.54	2^+	D,Q	α(K)exp=0.00083 *18* Mult.: D,Q from α(K)exp, Q from Adopted ΔJ.
1261.8	364 *10*	2080.00	2^+	818.54	2^+	D,Q	α(K)exp=0.0024 *3*
1310.6	33 *8*	2128.83	2^+	818.54	2^+	D,Q	
1323.0		2141.37	0^+	818.54	2^+		
1403.6[af] *6*	20 *6*	2222.44	$(2)^+$	818.54	2^+		
1441.9[a] *10*	11 *4*	3021.44	$(1,2^+)$	1578.57	0^+		
1469.0[a] *10*		3021.44	$(1,2^+)$	1551.01	2^+		

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^{135}Ba(n,γ) E=thermal 1990Is07,1983BrZK,1969Ge07 (continued)

$\gamma(^{136}Ba)$ (continued)

E_γ †	I_γ ‡ e	E_i(level)	J_i^π	E_f	J_f^π	Mult. #	$I_{(\gamma+ce)}$ @ e	Comments
1496.9 a		2315.38	0^+	818.54	2^+			
1536.5 a 6	19 5	2355.1	4^+	818.54	2^+			
1551.04 8	97 11	1551.01	2^+	0.0	0^+	E2		α(K)exp=0.00076 13
1572 a c f		2390.59	3^-	818.54	2^+			
1579.819		1578.57	0^+	0.0	0^+	E0	0.023 CA	ce(L)/(γ+ce)=0.11 E_γ: from 1980GeZU. Note that energies cited by 1980GeZU are ≈0.2 keV higher than those cited by 1983BrZK. Mult.: no γ of this energy observed (1980GeZU). $I_{(\gamma+ce)}$: from ce(K) and ce(K)/ce (evaluator). ce(K)=1066; ce(K)/ce=0.89. B(E0)(1580γ)/B(E2)(761γ)=0.11 2 (1985CoZR,1980GeZU).
1581.50 6	37.2 24	2399.98	$(1^+,2^+)$	818.54	2^+			
x 1613.73 9	67 8							
1666.81 16	22 6	2485.27	2^+	818.54	2^+			
1713.2 a 6	29 4	2532.54	3^-	818.54	2^+			
1798.4 a 7	10 4	3925.45		2128.83	2^+			
x 1821.90 12	22 4							
1842.99 15	22 3	2661.36	$1,2^+$	818.54	2^+			
1874.96 10	10.4 16	2693.53	1	818.54	2^+			
1955.19 17	12 3	3506.21	$0^{(+)},1,2,3^+$	1551.01	2^+			
1993.6 2	8 3	2811.72	(3^+)	818.54	2^+			
2080.03 5	28.9 18	2080.00	2^+	0.0	0^+			
x 2083.31 11	9.6 13							
2128.89 5	44.5 23	2128.83	2^+	0.0	0^+			
x 2141.35 6	7.4 7							E_γ: 1990Is07 place this as a transition from a 2141-keV level. As the Adopted J^π for the 2141-keV level is 0^+, such a transition is not allowed.
2153.53 8	8.1 7	2153.55		0.0	0^+			
2201.0 a 4	11 4	3021.44	$(1,2^+)$	818.54	2^+			
2224.8 a 20		3044.90	$1^{(-)}$	818.54	2^+			
2244.0 a 10	5 3	3794.88	$(1,2^+)$	1551.01	2^+			
x 2374.16 18	5.6 14							E_γ: 1990Is07 place this as a transition from a 2374-keV level. As the Adopted J^π for the 2374-keV level is $(5)^+$, that would suggest a highly unlikely M5 character for this transition.
2429.6 3	3.3 10	4008.2	$1,2^+$	1578.57	0^+			
2441.55 19	5.6 11	3992.58	$0^{(+)},1,2,3^+$	1551.01	2^+			
2485.22 7	13.5 9	2485.27	2^+	0.0	0^+			
x 2689.20 7	12.6 14							
2693.97 11	6.8 12	2693.53	1	0.0	0^+			
2773.32 11	4.8 8	2773.51	2^+	0.0	0^+			
2873.36 13	9.5 23	3691.93	1 to 3	818.54	2^+			
2976.04 5	69.9 20	3794.88	$(1,2^+)$	818.54	2^+			
3044.51 5	13.0 6	3044.90	$1^{(-)}$	0.0	0^+			
3116.4 5	8 3	3116.19	2^+	0.0	0^+			
3370.8 3	5.1 8	3370.8	1	0.0	0^+			
3436.18 d 9	20 4	3435.57	1^-	0.0	0^+			

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^{135}Ba(n,γ) E=thermal 1990Is07,1983BrZK,1969Ge07 (continued)

γ(^{136}Ba) (continued)

E_γ †	I_γ ‡ e	E_i(level)	J_i^π	E_f	J_f^π
x3738.22 d 7	13.6 8				
3795.24 18	2.1 7	3794.88	(1,2$^+$)	0.0	0$^+$
3863.41 23	3.3 13	3863.47	(1,2$^+$)	0.0	0$^+$
3965.28 d 6	10.7 5	3965.51	(1,2$^+$)	0.0	0$^+$
3980.41 9	5.6 4	3980.36	(1)	0.0	0$^+$
4137.29 8	6.1 6	4137.36	1	0.0	0$^+$
x4318.8 3	4.9 9				
x4424.51 10	11.0 10				
x4508.64 9	11.4 11				
x4728.65 11	4.8 3				
x4925.13 6	7.6 5				
x4992.06 24	1.3 4				
5127.41 14	3.4 3	(9107.74)	2	3980.36	(1)
5141.84 6	4.8 3	(9107.74)	2	3965.51	(1,2$^+$)
5312.39 5	31 1	(9107.74)	2	3794.88	(1,2$^+$)
5340.24 10	4.5 3	(9107.74)	2	3767.41	1$^{(-)}$,2,3$^+$
5672.32 7	6.57 25	(9107.74)	2	3435.57	1$^-$
5991.32 17	1.6 4	(9107.74)	2	3116.19	2$^+$
6062.36 4	19.8 3	(9107.74)	2	3044.90	1$^{(-)}$
6085.69 11	3.7 4	(9107.74)	2	3021.44	(1,2$^+$)
6112.13 17	0.85 11	(9107.74)	2	2995.34	
6295.93 13	0.83 12	(9107.74)	2	2811.72	(3$^+$)
6333.9 5	0.91 20	(9107.74)	2	2773.51	2$^+$
6413.89 22	1.01 17	(9107.74)	2	2693.53	1
6446.18 10	3.41 17	(9107.74)	2	2661.36	1,2$^+$
6466.72 11	2.85 14	(9107.74)	2	2640.74	(1$^+$)
6574.90 6	5.81 2	(9107.74)	2	2532.54	3$^-$
6676.97 15	1.72 12	(9107.74)	2	2430.47	3$^+$
6707.58 7	4.20 17	(9107.74)	2	2399.98	(1$^+$,2$^+$)
6716.84 23	0.87 10	(9107.74)	2	2390.59	3$^-$
6792.05 23	0.75 23	(9107.74)	2	2315.38	0$^+$
6884.97 10	2.08 13	(9107.74)	2	2222.44	(2)$^+$
6966.44 18	1.16 8	(9107.74)	2	2141.37	0$^+$
6978.91 11	2.10 10	(9107.74)	2	2128.83	2$^+$
7027.48 6	5.94 21	(9107.74)	2	2080.00	2$^+$
7053.75 24	1.0 3	(9107.74)	2	2053.78	4$^+$
7528.89 16	1.05 7	(9107.74)	2	1578.57	0$^+$
7556.43 7	4.52 15	(9107.74)	2	1551.01	2$^+$
8288.98 5	13.4 3	(9107.74)	2	818.54	2$^+$
9107.42 6	24.4 7	(9107.74)	2	0.0	0$^+$

† Except as noted, from 1990Is07 for transitions with Eγ≥1550, others from 1983BrZK. See 1990Is07 for unassigned γ′s observed in capture by natural barium.

‡ Iγ are per 1000 n captures. Iγ values from 1983BrZK and 1969Ge07 have been normalized to Iγ(1551γ)=97 *11* (1990Is07). A 16% uncertainty due to σ of ^{135}Ba should be added.

From γγ(θ) or α(K)exp.

@ Intensity on same scale as Iγ.

& Note possible discrepancy in the placement of this transition; γγ-coincidence data appear consistent with either placement (evaluator).

a From 1969Ge07.

b From 1983BrZK. Possible coin with 819γ.

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^{135}Ba(n,γ) E=thermal **1990Is07,1983BrZK,1969Ge07 (continued)**

$\gamma(^{136}Ba)$ (continued)

[c] Placement suggested by evaluator on basis of possible 819γ coincidence and (n,n$'\gamma$) or ε decay data.
[d] Possible contamination due to ^{138}Ba.
[e] For intensity per 100 neutron captures, multiply by 0.1.
[f] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

^{135}Ba(n,γ) E=thermal 1990Is07,1983BrZK,1969Ge07

Level Scheme

Intensities: Relative I_γ

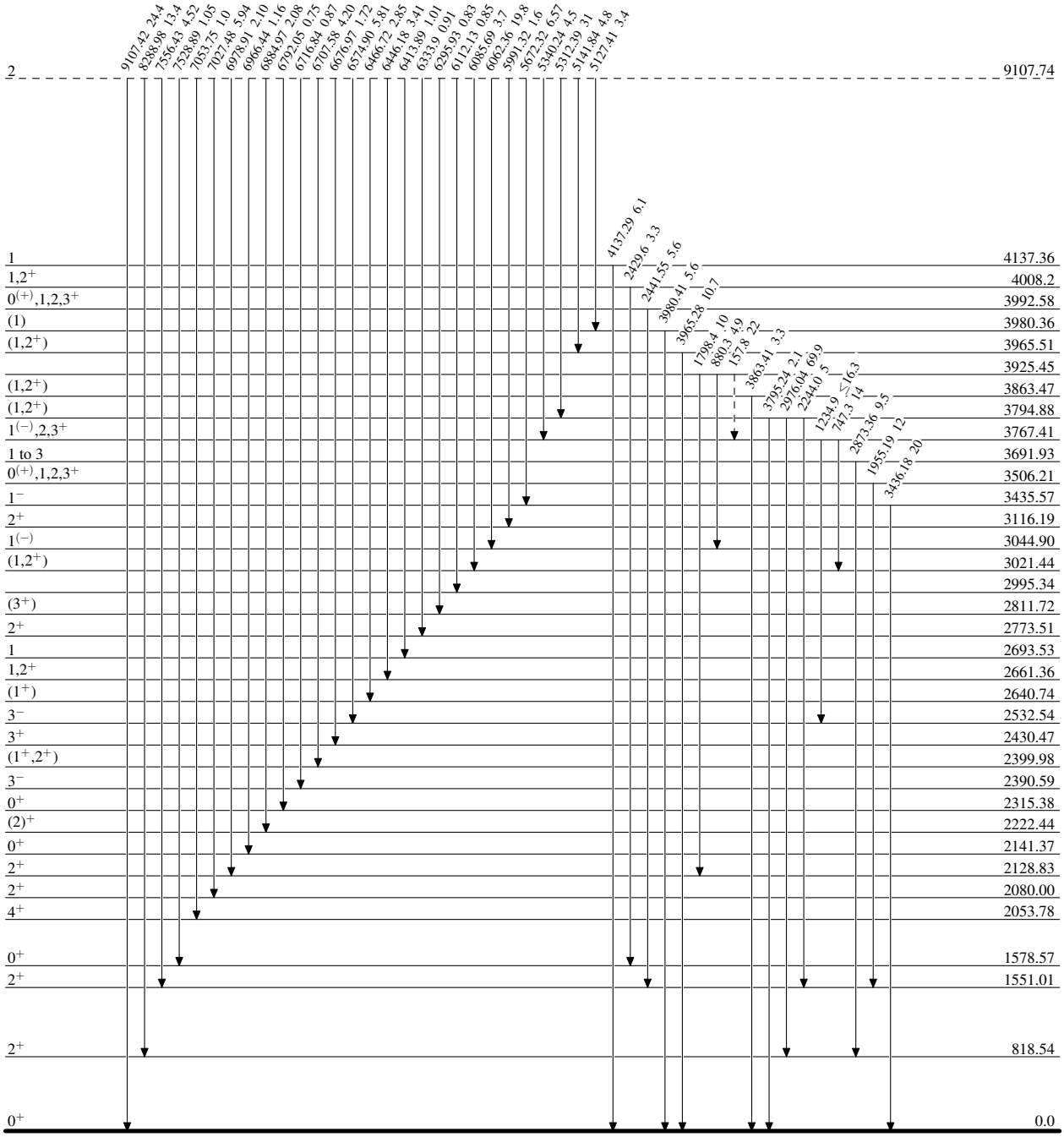
Legend

$I_\gamma < 2\% \times I_\gamma^{max}$

$I_\gamma < 10\% \times I_\gamma^{max}$

$I_\gamma > 10\% \times I_\gamma^{max}$

γ Decay (Uncertain)



$^{136}_{56}Ba_{80}$

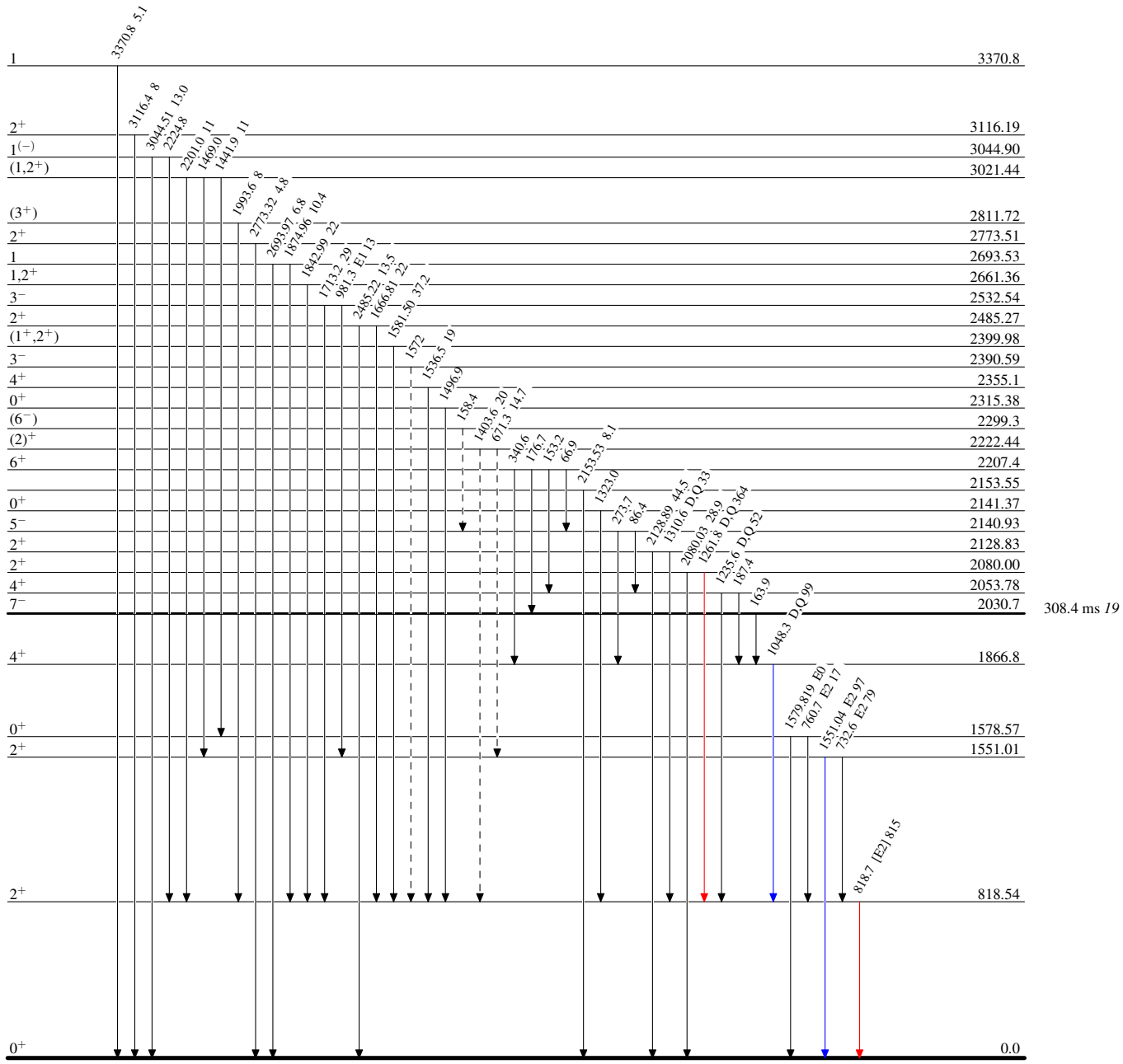
^{135}Ba(n,γ) E=thermal 1990Is07,1983BrZK,1969Ge07

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)

Level Scheme (continued)

Intensities: Relative I_γ



$^{136}_{56}Ba_{80}$