

$^{160}\text{Gd}(^{11}\text{B},\alpha 3\text{n}\gamma)$ 2004Ho19

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen [#]		NDS 147, 1 (2018)	30-Nov-2017

2004Ho19: E=61 MeV. Measured $E\gamma$, $I\gamma$, $\gamma\gamma$ with the GASP array, consisting of 40 Compton-suppressed large-volume Ge detectors, and a multiplicity filter of 80 BGO elements, providing the sum energy and γ -ray multiplicity.

1997Ma36: analyzed levels, J^π in high-spin data.

 ^{164}Ho Levels

E(level) [†]	J^π [‡]	$T_{1/2}$	Comments
0.0 ^e	1 ⁺		
37.36 ^d 21	2 ⁺		
94.2 ^e 3	3 ⁺		
140.1 ^{&} 4	6 ⁻	36.3 min 4	%IT=100 $T_{1/2}$: from Adopted Levels.
167.9 ^d 4	(4 ⁺)		
191.3 [#] 5	(6 ⁺)		
193.33 ^g 24	(1 ⁻)		
204.0 ^a 5	7 ⁻		
207.91 ^f 23	(2 ⁻)		
236.2 ^g 4	(3 ⁻)		
262.4 ^e 5	(5 ⁺)		
273.9 ^f 4	(4 ⁻)		
294.0 ^{&} 6	(8 ⁻)		
317.6 [@] 6	(7 ⁺)		
331.4 ^g 5	(5 ⁻)		
342.9 ^c 5	5 ⁺		
370.9 ^d 6	(6 ⁺)		
398.7 ^f 6	(6 ⁻)		
406.8 ^a 6	(9 ⁻)		
452.5 ^b 6	6 ⁺		
461.2 [#] 7	(8 ⁺)		
488.5 ^g 7	(7 ⁻)		
503.4 ^e 6	(7 ⁺)		
540.6 ^{&} 6	(10 ⁻)		
579.6 ^c 7	(7 ⁺)		
587.4 ^f 7	(8 ⁻)		
621.9 [@] 7	(9 ⁺)		
644.9 ^d 6	(8 ⁺)		
694.5 ^a 6	(11 ⁻)		
712.4 ^g 7	(9 ⁻)		
723.2 ^b 7	(8 ⁺)		
799.4 [#] 7	(10 ⁺)		
814.7 ^e 6	(9 ⁺)		
843.6 ^f 8	(10 ⁻)		
867.3 ^{&} 6	(12 ⁻)		
881.6 ^c 7	(9 ⁺)		
985.9 ^d 6	(10 ⁺)		
993.1 [@] 7	(11 ⁺)		

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$^{160}\text{Gd}(^{11}\text{B},\alpha 3\text{n}\gamma)$ **2004Ho19** (continued) ^{164}Ho Levels (continued)

E(level) [†]	J ^π [‡]	E(level) [†]	J ^π [‡]	E(level) [†]	J ^π [‡]	E(level) [†]	J ^π [‡]
1007.1 ^g 8	(11 ⁻)	1420.3 ^b 8	(12 ⁺)	1990.4 ^a 7	(17 ⁻)	2941.4 ^g 9	(19 ⁻)
1050.0 ^b 7	(10 ⁺)	1427.0 [@] 7	(13 ⁺)	2062.9 ^f 8	(16 ⁻)	3162.3 ^a 8	(21 ⁻)
1058.5 ^a 7	(13 ⁻)	1492.2 ^a 7	(15 ⁻)	2113.5 ^e 8	(15 ⁺)	3250.9 ^f 9	(20 ⁻)
1171.7 ^f 8	(12 ⁻)	1577.6 ^f 8	(14 ⁻)	2184.1 [#] 8	(16 ⁺)	3452.2 ^{&} 8	(22 ⁻)
1192.7 ^e 7	(11 ⁺)	1631.7 ^e 7	(13 ⁺)	2249.9 ^{&} 7	(18 ⁻)	3827.0 ^a 8	(23 ⁻)
1202.4 [#] 7	(12 ⁺)	1666.3 [#] 7	(14 ⁺)	2350.5 ^g 8	(17 ⁻)	4125.7 ^{&} 9	(24 ⁻)
1234.9 ^c 7	(11 ⁺)	1728.5 ^{&} 7	(16 ⁻)	2462.8 [@] 8	(17 ⁺)	4541.8 ^a 9	(25 ⁻)
1265.6 ^{&} 7	(14 ⁻)	1826.2 ^g 8	(15 ⁻)	2548.4 ^a 7	(19 ⁻)		
1377.6 ^g 8	(13 ⁻)	1865.3 ^d 7	(14 ⁺)	2624.4 ^f 9	(18 ⁻)		
1387.9 ^d 7	(12 ⁺)	1919.3 [@] 8	(15 ⁺)	2826.0 ^{&} 8	(20 ⁻)		

[†] From least-squares fit to E γ data; $\Delta E\gamma=0.3$ keV assumed for each transition.

[‡] Based on band structure, using adopted spin-parities of known states as references.

Band(A): $\pi 7/2[523]\otimes\nu 5/2[523], K^\pi=6^+, \alpha=0$.

@ Band(a): $\pi 7/2[523]\otimes\nu 5/2[523], K^\pi=6^+, \alpha=1$.

& Band(B): $\pi 7/2[523]\otimes\nu 5/2[642], K^\pi=6^-, \alpha=0$.

^a Band(b): $\pi 7/2[523]\otimes\nu 5/2[642], K^\pi=6^-, \alpha=1$.

^b Band(C): $\pi 7/2[523]\otimes\nu 3/2[521], K^\pi=5^+, \alpha=0$.

^c Band(c): $\pi 7/2[523]\otimes\nu 3/2[521], K^\pi=5^+, \alpha=1$.

^d Band(D): $\pi 7/2[523]\otimes\nu 5/2[523], K^\pi=1^+, \alpha=0$.

^e Band(d): $\pi 7/2[523]\otimes\nu 5/2[523], K^\pi=1^+, \alpha=1$.

^f Band(E): $\pi 7/2[523]\otimes\nu 5/2[642], K^\pi=1^-, \alpha=0$.

^g Band(e): $\pi 7/2[523]\otimes\nu 5/2[642], K^\pi=1^-, \alpha=1$.

 $\gamma(^{164}\text{Ho})$

E γ	E _i (level)	J _i ^π	E _f	J _f ^π	Mult.	Comments
37.3	37.36	2 ⁺	0.0	1 ⁺		
37.7	273.9	(4 ⁻)	236.2	(3 ⁻)		
45.9	140.1	6 ⁻	94.2	3 ⁺	E3	Mult.: from Adopted Gammas.
51.2	191.3	(6 ⁺)	140.1	6 ⁻		
56.7	94.2	3 ⁺	37.36	2 ⁺		
63.9	204.0	7 ⁻	140.1	6 ⁻		
67.3	398.7	(6 ⁻)	331.4	(5 ⁻)		
73.7	167.9	(4 ⁺)	94.2	3 ⁺		
89.8	488.5	(7 ⁻)	398.7	(6 ⁻)		
90.1	294.0	(8 ⁻)	204.0	7 ⁻		
94.5	262.4	(5 ⁺)	167.9	(4 ⁺)		
99.0	587.4	(8 ⁻)	488.5	(7 ⁻)		
108.5	370.9	(6 ⁺)	262.4	(5 ⁺)		
109.6	452.5	6 ⁺	342.9	5 ⁺		
112.7	406.8	(9 ⁻)	294.0	(8 ⁻)		
113.6	207.91	(2 ⁻)	94.2	3 ⁺		
125.1	712.4	(9 ⁻)	587.4	(8 ⁻)		
126.3	317.6	(7 ⁺)	191.3	(6 ⁺)		
127.3	579.6	(7 ⁺)	452.5	6 ⁺		
131.1	843.6	(10 ⁻)	712.4	(9 ⁻)		
132.5	503.4	(7 ⁺)	370.9	(6 ⁺)		

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$^{160}\text{Gd}(^{11}\text{B},\alpha 3n\gamma)$ **2004Ho19** (continued) $\gamma(^{164}\text{Ho})$ (continued)

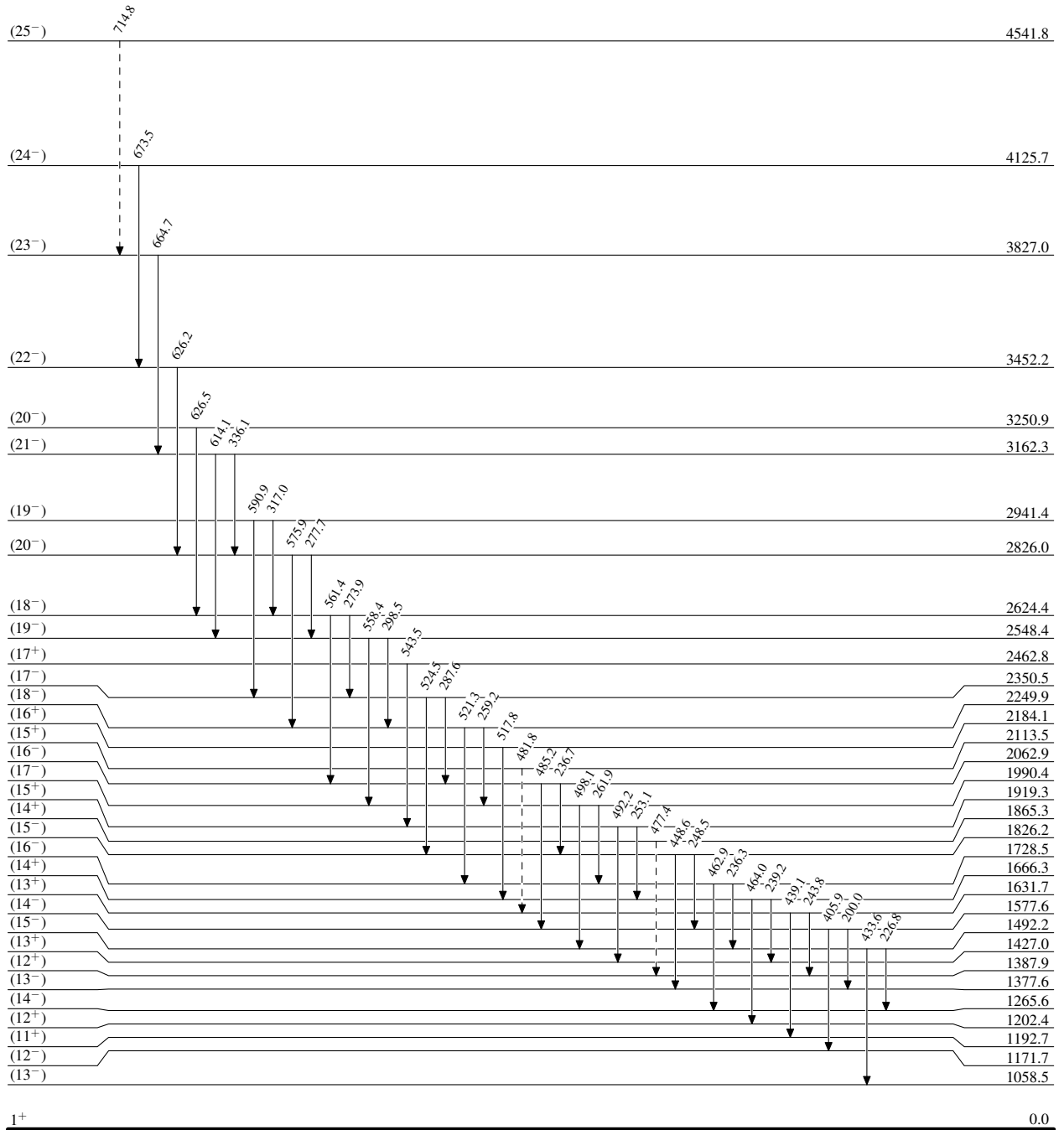
E_γ	$E_i(\text{level})$	J_i^π	E_f	J_f^π	E_γ	$E_i(\text{level})$	J_i^π	E_f	J_f^π
133.7	540.6	(10 ⁻)	406.8	(9 ⁻)	287.6	694.5	(11 ⁻)	406.8	(9 ⁻)
141.3	644.9	(8 ⁺)	503.4	(7 ⁺)	287.6	2350.5	(17 ⁻)	2062.9	(16 ⁻)
143.5	461.2	(8 ⁺)	317.6	(7 ⁺)	294.8	1007.1	(11 ⁻)	712.4	(9 ⁻)
143.6	723.2	(8 ⁺)	579.6	(7 ⁺)	298.5	2548.4	(19 ⁻)	2249.9	(18 ⁻)
153.9	694.5	(11 ⁻)	540.6	(10 ⁻)	302.0	881.6	(9 ⁺)	579.6	(7 ⁺)
156.0	193.33	(1 ⁻)	37.36	2 ⁺	304.5	621.9	(9 ⁺)	317.6	(7 ⁺)
158.2	881.6	(9 ⁺)	723.2	(8 ⁺)	311.5	814.7	(9 ⁺)	503.4	(7 ⁺)
160.7	621.9	(9 ⁺)	461.2	(8 ⁺)	317.0	2941.4	(19 ⁻)	2624.4	(18 ⁻)
163.5	331.4	(5 ⁻)	167.9	(4 ⁺)	326.7	867.3	(12 ⁻)	540.6	(10 ⁻)
163.6	1007.1	(11 ⁻)	843.6	(10 ⁻)	326.9	1050.0	(10 ⁺)	723.2	(8 ⁺)
164.5	1171.7	(12 ⁻)	1007.1	(11 ⁻)	328.1	1171.7	(12 ⁻)	843.6	(10 ⁻)
168.4	1050.0	(10 ⁺)	881.6	(9 ⁺)	336.1	3162.3	(21 ⁻)	2826.0	(20 ⁻)
169.8	814.7	(9 ⁺)	644.9	(8 ⁺)	338.1	799.4	(10 ⁺)	461.2	(8 ⁺)
170.6	207.91	(2 ⁻)	37.36	2 ⁺	340.8	985.9	(10 ⁺)	644.9	(8 ⁺)
171.2	985.9	(10 ⁺)	814.7	(9 ⁺)	353.3	1234.9	(11 ⁺)	881.6	(9 ⁺)
172.9	867.3	(12 ⁻)	694.5	(11 ⁻)	363.9	1058.5	(13 ⁻)	694.5	(11 ⁻)
177.5	799.4	(10 ⁺)	621.9	(9 ⁺)	370.3	1420.3	(12 ⁺)	1050.0	(10 ⁺)
179.8	273.9	(4 ⁻)	94.2	3 ⁺	370.6	1377.6	(13 ⁻)	1007.1	(11 ⁻)
185.0	1234.9	(11 ⁺)	1050.0	(10 ⁺)	371.2	993.1	(11 ⁺)	621.9	(9 ⁺)
191.2	1058.5	(13 ⁻)	867.3	(12 ⁻)	378.2	1192.7	(11 ⁺)	814.7	(9 ⁺)
193.3	193.33	(1 ⁻)	0.0	1 ⁺	398.5	1265.6	(14 ⁻)	867.3	(12 ⁻)
193.6	993.1	(11 ⁺)	799.4	(10 ⁺)	402.0	1387.9	(12 ⁺)	985.9	(10 ⁺)
195.1	1387.9	(12 ⁺)	1192.7	(11 ⁺)	403.1	1202.4	(12 ⁺)	799.4	(10 ⁺)
198.8	236.2	(3 ⁻)	37.36	2 ⁺	405.9	1577.6	(14 ⁻)	1171.7	(12 ⁻)
200.0	1577.6	(14 ⁻)	1377.6	(13 ⁻)	433.6	1492.2	(15 ⁻)	1058.5	(13 ⁻)
202.8	342.9	5 ⁺	140.1	6 ⁻	433.7	1427.0	(13 ⁺)	993.1	(11 ⁺)
202.8	406.8	(9 ⁻)	204.0	7 ⁻	439.1	1631.7	(13 ⁺)	1192.7	(11 ⁺)
205.8	1377.6	(13 ⁻)	1171.7	(12 ⁻)	448.6	1826.2	(15 ⁻)	1377.6	(13 ⁻)
206.7	1192.7	(11 ⁺)	985.9	(10 ⁺)	462.9	1728.5	(16 ⁻)	1265.6	(14 ⁻)
207.1	1265.6	(14 ⁻)	1058.5	(13 ⁻)	464.0	1666.3	(14 ⁺)	1202.4	(12 ⁺)
208.0	207.91	(2 ⁻)	0.0	1 ⁺	477.4 [†]	1865.3	(14 ⁺)	1387.9	(12 ⁺)
209.4	1202.4	(12 ⁺)	993.1	(11 ⁺)	481.8 [†]	2113.5	(15 ⁺)	1631.7	(13 ⁺)
223.8	712.4	(9 ⁻)	488.5	(7 ⁻)	485.2	2062.9	(16 ⁻)	1577.6	(14 ⁻)
224.8	1427.0	(13 ⁺)	1202.4	(12 ⁺)	492.2	1919.3	(15 ⁺)	1427.0	(13 ⁺)
226.8	1492.2	(15 ⁻)	1265.6	(14 ⁻)	498.1	1990.4	(17 ⁻)	1492.2	(15 ⁻)
236.3	1728.5	(16 ⁻)	1492.2	(15 ⁻)	517.8	2184.1	(16 ⁺)	1666.3	(14 ⁺)
236.7	2062.9	(16 ⁻)	1826.2	(15 ⁻)	521.3	2249.9	(18 ⁻)	1728.5	(16 ⁻)
239.2	1666.3	(14 ⁺)	1427.0	(13 ⁺)	524.5	2350.5	(17 ⁻)	1826.2	(15 ⁻)
241.0	503.4	(7 ⁺)	262.4	(5 ⁺)	543.5	2462.8	(17 ⁺)	1919.3	(15 ⁺)
243.8	1631.7	(13 ⁺)	1387.9	(12 ⁺)	558.4	2548.4	(19 ⁻)	1990.4	(17 ⁻)
246.7	540.6	(10 ⁻)	294.0	(8 ⁻)	561.4	2624.4	(18 ⁻)	2062.9	(16 ⁻)
248.5	1826.2	(15 ⁻)	1577.6	(14 ⁻)	575.9	2826.0	(20 ⁻)	2249.9	(18 ⁻)
253.1	1919.3	(15 ⁺)	1666.3	(14 ⁺)	590.9	2941.4	(19 ⁻)	2350.5	(17 ⁻)
256.2	843.6	(10 ⁻)	587.4	(8 ⁻)	614.1	3162.3	(21 ⁻)	2548.4	(19 ⁻)
259.2	2249.9	(18 ⁻)	1990.4	(17 ⁻)	626.2	3452.2	(22 ⁻)	2826.0	(20 ⁻)
261.9	1990.4	(17 ⁻)	1728.5	(16 ⁻)	626.5	3250.9	(20 ⁻)	2624.4	(18 ⁻)
270.6	723.2	(8 ⁺)	452.5	6 ⁺	664.7	3827.0	(23 ⁻)	3162.3	(21 ⁻)
273.9	2624.4	(18 ⁻)	2350.5	(17 ⁻)	673.5	4125.7	(24 ⁻)	3452.2	(22 ⁻)
274.0	644.9	(8 ⁺)	370.9	(6 ⁺)	714.8 [†]	4541.8	(25 ⁻)	3827.0	(23 ⁻)
277.7	2826.0	(20 ⁻)	2548.4	(19 ⁻)					

[†] Placement of transition in the level scheme is uncertain.

$^{160}\text{Gd}(^{11}\text{B}, \alpha 3n\gamma)$ 2004Ho19

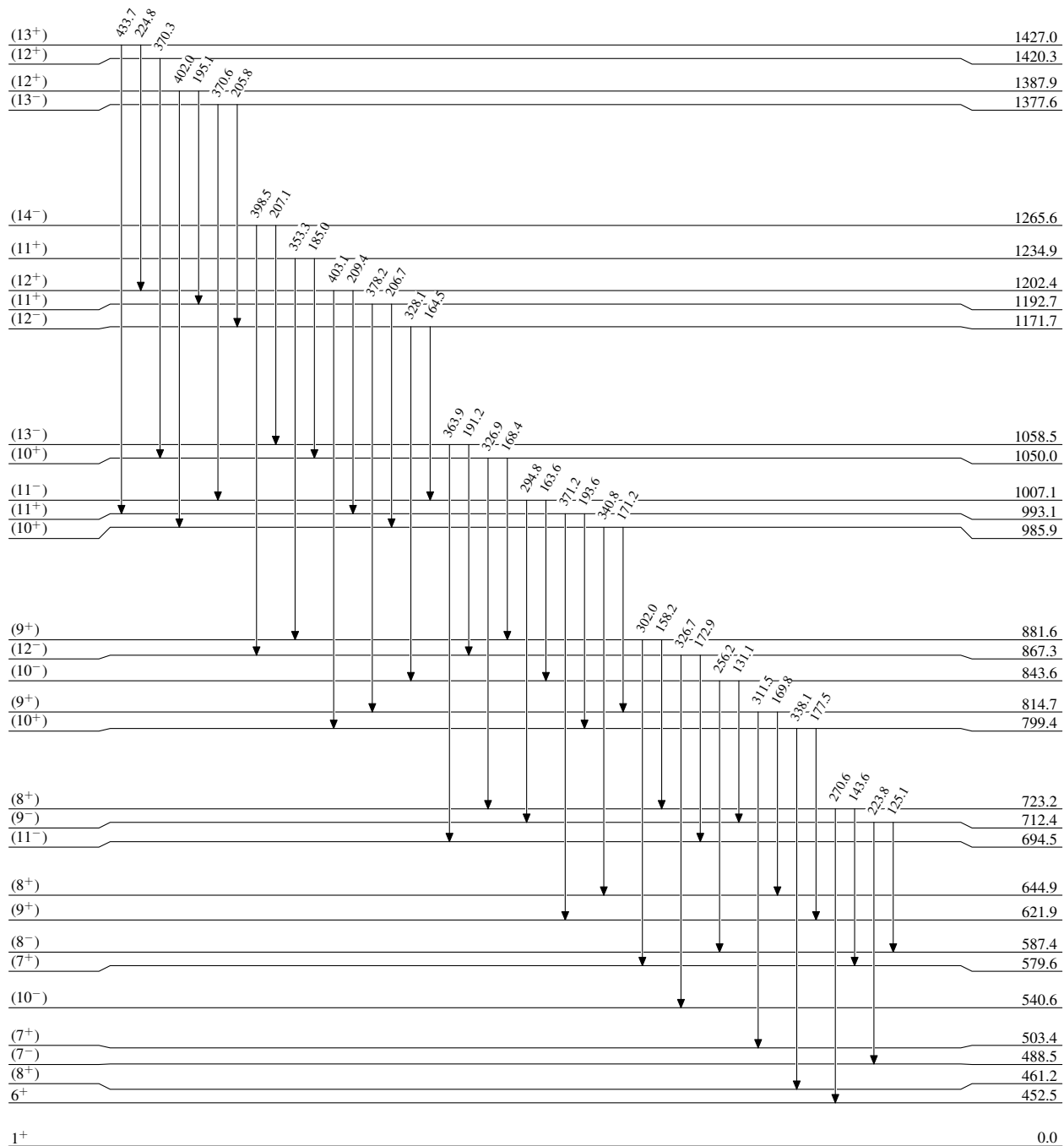
Legend

Level Scheme

-----► γ Decay (Uncertain)

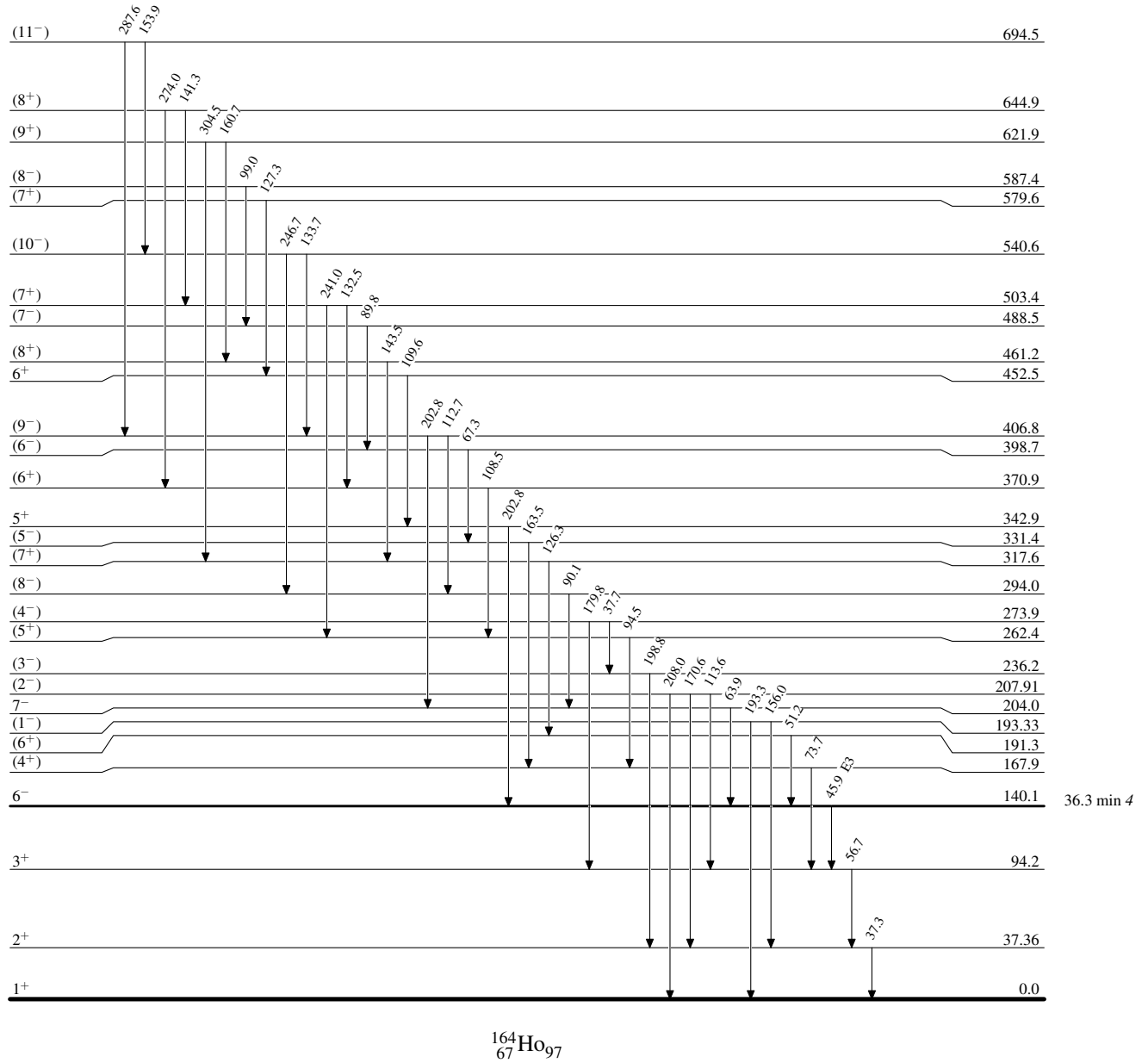
$^{160}\text{Gd}(^{11}\text{B}, \alpha 3n \gamma)$ 2004Ho19

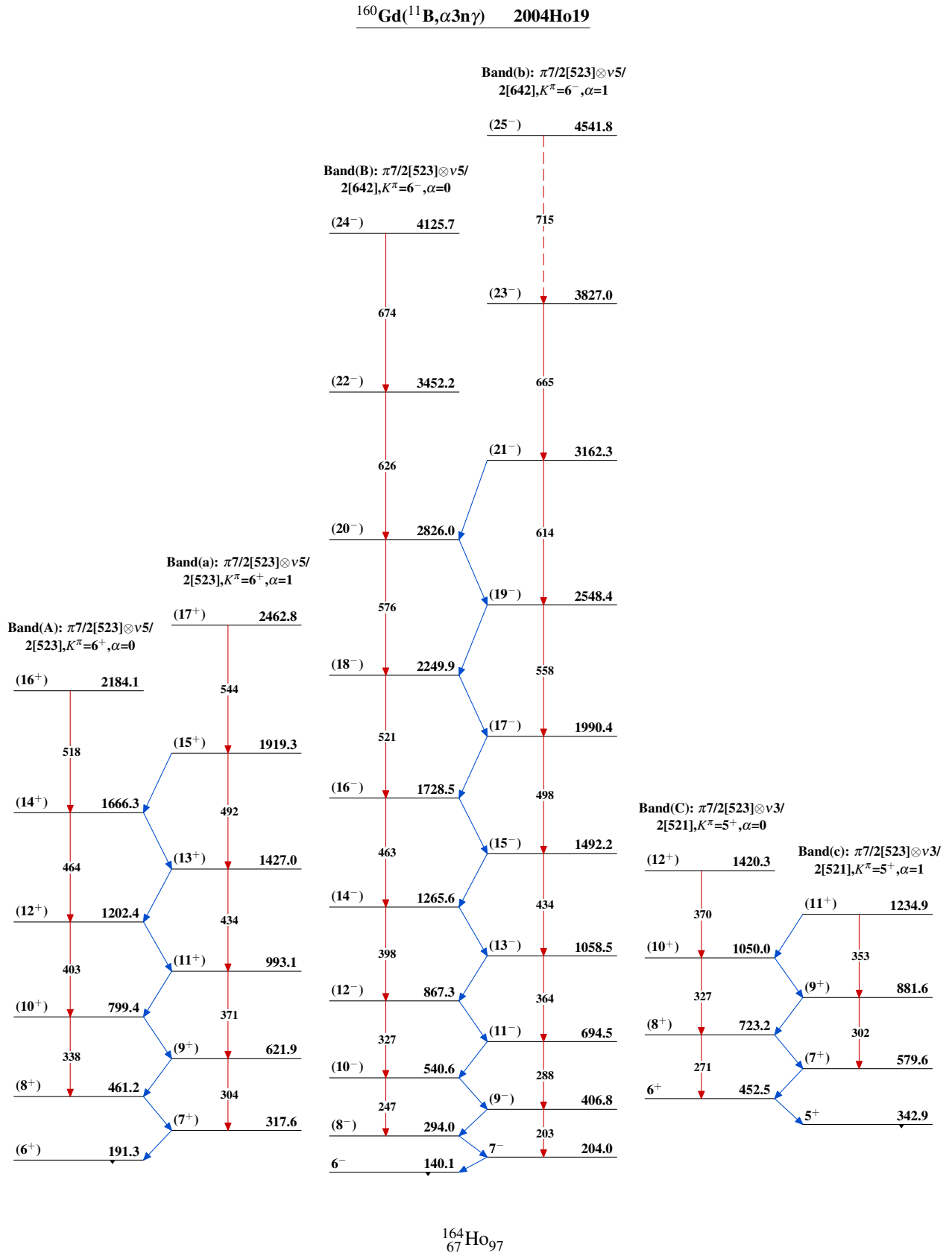
Level Scheme (continued)



$^{160}\text{Gd}(^{11}\text{B}, \alpha 3n\gamma)$ 2004Ho19

Level Scheme (continued)

 $^{164}\text{Ho}_{97}$



$^{160}\text{Gd}(^{11}\text{B}, \alpha 3n\gamma)$ 2004Ho19 (continued)