Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	M. J. Martin	NDS 114, 1497 (2013)	31-Aug-2013

Q(β^-)=−3104 *10*; S(n)=8053 *15*; S(p)=2141 *13*; Q(α)=4507.4 *13* 2017Wa10
Q(ε)=6513 *13*; S(2n)=17802 *15*; S(2p)=7077 *13*; Q(εp)=730 *13* 2017Wa10
Additional information 1.
Calculations:
Binding energy, <r^2>, multipole moments: 1993Pa04.
Level configurations from β decay: 1990So04.

^{152}Ho Levels

1979Ha29, 1980Bo07 and 1980Ja16 have searched for high spin isomers in this mass region. For the results of this search, see (HI,xnγ) data set.
1980Vr01 have searched for α decay from high spin isomers following (HI,xnγ) reactions with negative results.
The 19 s α activity with Eα=4460 *10* (1971To10) previously assigned to ^{156}Tm high spin decay to the ^{152}Ho high spin isomer is now believed to be a misassignment. This activity was not observed in: 1) ^{148}Sm(^{14}N,6n) reaction, which should have populated high-spin levels (1980Zo02); 2) in a ^{156}Tm source produced by W(600-MeV p) ms (1992Po14).

Cross Reference (XREF) Flags

- A ^{152}Er ε decay
- B ^{156}Tm α decay (83.8 s)
- C (HI,xnγ)

E(level)†	J$^\pi$‡	T$_{1/2}$&	XREF	Comments
0.0	2$^-$	161.8 s *3*	AB	%α=12 *3*; %ε+%β^+=88 *3* μ=−1.02 *2* (2005St24,1989Al27); Q=+0.08 *24* (2005St24,1989Al27) J$^\pi$: HF(α)=2.6 for α decay to 2$^-$ ^{148}Tb, γ from 1$^+$ is E1. T$_{1/2}$: from 1982Bo04. Others: 135 s *9* (1993Al03), 143 s *13* (1989Ga11), 154 s *5* (1982Ba75), 141 s *7* (1963Ma17). %α: %α=12 *3* (1977Ha48). AVRSQ**1/2=5.07 fm *4* (2004An14).
160[a] *1*	9$^+$	49.8 s *2*	C	%α=10.8 *17*; %ε+%β^+=89.2 *17* μ=+5.94 *5* (2005St24,1989Al27); Q=−1.3 *8* (2005St24,1989Al27) E(level): from 1987StZU based upon α decay of the 9$^+$ and 2$^-$ isomers. J$^\pi$: log *ft*=4.6 to 8$^+$ and 5.9 to 10$^+$ in ^{152}Dy. T$_{1/2}$: Weighted average of 49.5 s *3* (1990Sa32), 50.3 s *3* (1989Ga11), 49.5 s *3* (1982Ba75,1981Ga36), 49.7 *4* (1982Bo04), 50.0 s *8* (1993Al03). other: 52.3 s *5* (1963Ma17). The units of minutes quoted by 1993Al03 is assumed by the evaluator to be a misprint. The value of 1963Ma17 is excluded by chauvenet's criterion. %α: weighted average of 11 *2* (1981Ga36) and 10.5 *30* (1979To09); others: 6.4 *13* (1974Sc19), 19 *5* (1963Ma17).
179.4	1$^+$		A	J$^\pi$: log *ft*=4.1 from ^{152}Er 0$^+$ parent.
219.71 *9*	(8)$^+$#		C	
576.22[b] *11*	(9$^+$)#		C	
706.01[c] *13*	(10$^+$)#		C	
919.43[a] *14*	11$^+$		C	J$^\pi$: E2 γ to 9$^+$ level; excit.
1345.64[b] *12*	(11$^+$)#		C	

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Adopted Levels, Gammas (continued)

^{152}Ho Levels (continued)

E(level)[†]	Jπ[‡]	$T_{1/2}$[&]	XREF	Comments
1503.44[c] *25*	(12^+)[#]		C	
1631.88[a] *15*	13^+		C	Jπ: E2 γ to 11^+ level; excit.
1968.66[b] *13*	(13^+)[#]		C	
2025.47[c] *15*	(14^+)[#]		C	
2236.21[b] *15*	15^+		C	Jπ: E2 γ to 13^+ level; excit.
2285.49[c] *16*	16^+		C	Jπ: M1+E2 γ to 15^+ level; no γ to J≤15.
3019.59[e] *19*	19^-	8.4 μs *3*	C	Proton configuration=$(\pi,h_{11/2})^{+3}_{9/2}$. Jπ: E3 γ to 16^+ level.
3456.9[d] *4*	18^+[@]		C	Jπ: γ from 20^+ and γ to 16^+.
3531.2[e] *3*	20^-		C	Proton configuration=$(\pi,h_{11/2})^{+3}_{11/2}$; J-1 anomaly (1994An13). Jπ: M1(+E2) γ to 19^- level.
4235.0 *3*	21^+		C	Configuration=$((\pi,h_{11/2})^{+3}_{27/2}(\nu\ f_{7/2})^{+3}_{15/2})$. Jπ: E1 γ to $(20)^-$ level.
4270.02 *25*	20^+		C	E(level),Jπ: Proposed by 1994An13. E2 γ from 22^+, γ to 19^-.
4298.82[d] *25*	20^+		C	Jπ: E2 γ from 22^+ level.
4484.9 *4*			C	
4685.6[d] *3*	22^+		C	Jπ: M1(+E2) γ to $(21)^+$ level.
4883.75[d] *25*	24^+	5 ns *2*	C	Jπ: E2 γ to 22^+ level.
5697.0 *4*	25^+		C	Jπ: M1(+E2) γ to $(24)^+$ level.
5749.0[e] *3*	25^-		C	Proton configuration=$(\pi,h_{11/2})^{+3}_{21/2}$. Jπ: E1 γ to 24^+ level.
5892.4[e] *3*	26^-		C	Proton configuration=$(\pi,h_{11/2})^{+3}_{23/2}$. Jπ: M1(+E2) γ to 25^- level.
5920.4 *5*			C	
5971.6? *4*	26^-		C	
5997.9[e] *4*	28^-	47 ns *7*	C	Proton configuration=$(\pi,h_{11/2})^{+3}_{27/2}$. Jπ: E2 γ to 26^- level. $T_{1/2}$: from 1980Ja16. Other: 49 ns *7* (1988Pi10).
6047.4 *4*	(25^-)		C	
6589.7 *5*	(27^-)		C	E(level): 6440 KeV is a misprint in Fig 4 and Table I of 1997Ri02.
6739.3 *6*			C	
7071.6 *5*	$29^{(+)}$		C	
7360.7 *5*	$30^{(+)}$		C	
7633.7 *6*	(29^-)		C	
8016.2 *5*	$30^{(+)}$		C	
8266.4 *7*			C	
8281.1 *5*	$31^{(+)}$		C	
8636.7 *5*	$32^{(+)}$		C	
8641.9 *7*			C	
8929.5 *6*	$33^{(+)}$		C	
8934.1 *8*			C	
9260.5 *8*			C	
9549.0 *6*			C	
9560.8 *6*			C	
9663.5 *6*	$33^{(+)}$		C	
9915.6 *6*	$34^{(-)}$		C	
10032.9 *6*	$34^{(-)}$		C	
10220.5 *6*	$34^{(-)}$		C	
10221.2 *7*			C	
10247.6 *6*			C	
10397.4 *6*			C	
10504.7 *6*	$35^{(-)}$		C	

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Adopted Levels, Gammas (continued)

^{152}Ho Levels (continued)

E(level)[†]	J$^{\pi}$[‡]	XREF	Comments
10854.4 *7*		C	
11004.5 *7*		C	
11295.0 *7*		C	
11540.9 *7*	(37$^-$)	C	
11932.6 *7*	(38)	C	
12451.6 *8*		C	
12795.1 *8*		C	
12939.4 *8*		C	
x		C	E(level): Transitions from E=x and higher levels with E="+X" are observed to feed into levels above E=7072.
837.6+x *3*		C	$T_{1/2}$: On the basis of the observation that the 253γ feeding this level is stronger than the deexciting 837γ,1997Ri02 suggest that the 837+x level May be an isomer with a lifetime of roughly a few nanoseconds.
1090.6+x *5*		C	
1588.3+x *6*		C	
1862.4+x *5*		C	
2399.1+x *5*		C	
2489.2+x *6*		C	
2934.8+x *6*		C	
3633.5+x *6*		C	
3721.6+x *7*		C	
3796.1+x *7*		C	
4319.6+x *7*		C	
4362.2+x *7*		C	
4945.0+x *8*		C	

[†] Except for the 160 and 179.4 levels, all values are from (HI,xnγ). Values in that dataset were given relative to the 9$^+$ level at 160 set to zero. Values given here are based on E=160 for that isomer but the uncertainty is not included. To get the absolute uncertainty for the excitation energies from this reaction, an additional uncertainty of 1 keV should be included.

[‡] For the levels above 200 keV, the assignments are from (HI,xnγ). assignments for levels up to 3020 are from 1994An13. The strong assignments are based on γ mults and excitation functions. The assignments in parens are probable values based on the linking transitions and a comparison with levels in adjacent nuclides. assignments for higher levels are from 1997Ri02 based on angular distributions and DCO ratios. For these levels, the evaluator has added arguments based on mults determined by 1994An13.

[#] Given the firm assignments to the 160, 919, 1632, 2236, and 2285 levels, and given mults of M1(+E2) for the 356γ and mult=M1 or E2 for the 59.7γ and 129γ, then if one assumes M1 or E2 for the other connecting transitions, one can establish the following J$^{\pi}$ assignments for the levels between 160 and 2285: 8$^+$ to 11$^+$ for E=220, 9$^+$ to 13$^+$ for E=576, 9$^+$ to 11$^+$ for E=706, 11$^+$ for E=1345, 12$^+$,13$^+$ for E=1504, 13$^+$ for E=1969, and 14$^+$,15$^+$ for E=2026. 1994An13 have narrowed the choices to those adopted by comparing assignments in adjacent nuclei.

[@] The order of the cascading 842γ and 1171γ has not been established. The reversed order would give E(level)=3127.6.

[&] From (HI,xnγ), unless otherwise noted.

[a] Band(A): $(\pi,h_{11/2})^{+3}_{11/2}(\nu,f_{7/2})^{+3}$.

[b] Band(B): $(\pi,h_{11/2})^{+3}_{9/2}(\nu,h_{9/2})(\nu,f_{7/2})^{+2}$.

[c] Band(C): $(\pi,h_{11/2})^{+3}_{11/2}(\nu,h_{9/2})(\nu,f_{7/2})^{+2}$.

[d] Band(D): $(\pi,h_{11/2})^{+3}_{27/2}(\nu,h_{9/2})(\nu,f_{7/2})^{+2}$.

[e] Band(E): $(\pi,h_{11/2})^{+3}_{9/2}(\nu,f_{7/2})(\nu,h_{9/2})(\nu,i_{13/2})$.

Adopted Levels, Gammas (continued)

$\gamma(^{152}Ho)$

All γ data are from (HI,xnγ) data set, unless otherwise noted.

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.	δ	$\alpha^\ddagger$	Comments
179.4	1^+	179.4†		0.0	2^-	E1†		0.0669	α(K)= 0.0566; α(L)=0.00835; α(M)=0.00183; α(N+..)=0.00051
219.71	$(8)^+$	59.7 *1*		160	9^+	M1,E2		17 *5*	
576.22	(9^+)	356.5 *1*		219.71	$(8)^+$	M1(+E2)	<0.8	0.070 *18*	
706.01	(10^+)	129.8 *1*	100 *9*	576.22	(9^+)	M1,E2		1.1 *3*	
		546.0 *3*	66 *20*	160	9^+				
919.43	11^+	759.5 *2*		160	9^+	E2		0.0058	
1345.64	(11^+)	639.6 *3*	<124	706.01	(10^+)				
		769.4 *1*	100 *7*	576.22	(9^+)				
		1185.6 *2*	26 *10*	160	9^+				
1503.44	(12^+)	797.5 *3*		706.01	(10^+)				
1631.88	13^+	712.4 *1*		919.43	11^+	E2		0.0067	
1968.66	(13^+)	336.8 *3*	22 *3*	1631.88	13^+				
		623.0 *1*	100 *4*	1345.64	(11^+)				
		1049.5 *2*	38 *3*	919.43	11^+				
2025.47	(14^+)	56.8 *1*	4.4 *11*	1968.66	(13^+)				
		393.4 *3*		1631.88	13^+				
		522.1 *3*	<100	1503.44	(12^+)				
2236.21	15^+	267.6 *1*	7.9 *10*	1968.66	(13^+)				
		604.3 *1*	100.0 *24*	1631.88	13^+	E2		0.0098	
2285.49	16^+	49.3 *1*	100 *27*	2236.21	15^+	M1+E2	0.21 *10*	5.5 *18*	
		260.0 *1*	72 *6*	2025.47	(14^+)				
3019.59	19^-	734.1 *1*		2285.49	16^+	E3		0.0151	B(E3)(W.u.)=0.90 *4*
3456.9	18^+	1171.5 *4*		2285.49	16^+				
3531.2	20^-	511.7 *3*		3019.59	19^-	M1(+E2)	<0.48	0.0289 *19*	
4235.0	21^+	703.8 *1*	100.0 *11*	3531.2	20^-	E1		0.0026	
		1215.3 *3*	1.5 *4*	3019.59	19^-				
4270.02	20^+	1250.4 *2*		3019.59	19^-				
4298.82	20^+	842.0 *5*		3456.9	18^+				
		1279.2 *2*		3019.59	19^-				
4484.9		250.1 *3*		4235.0	21^+				
4685.6	22^+	386.8 *2*	<41	4298.82	20^+	E2		0.0316	
		415.6 *2*	20.8 *8*	4270.02	20^+	E2		0.0259	α(K)=0.0204; α(L)=0.00439; α(M)=0.00100; α(N+..)=0.00027
		450.6 *1*	100.0 *19*	4235.0	21^+	M1(+E2)	<0.8	0.038 *4*	
4883.75	24^+	198.1 *1*		4685.6	22^+	E2		0.252	
		399.0 *3*		4484.9					
5697.0	25^+	813.5 *3*		4883.75	24^+	M1		0.0095	
5749.0	25^-	865.2 *1*		4883.75	24^+	E1		0.0017	
5892.4	26^-	143.4 *1*	100 *3*	5749.0	25^-	M1(+E2)	<0.82	0.90 *4*	
		195.5 *2*	30 *3*	5697.0	25^+				
5920.4		223.4 *3*		5697.0	25^+				
5971.6?	26^-	222.5 *3*		5749.0	25^-				
5997.9	28^-	105.5 *1*		5892.4	26^-	E2		2.31	B(E2)(W.u.)=5.8 +*10*−*8*
6047.4	(25^-)	75.7 *3*		5971.6?	26^-				
		155.1 *3*		5892.4	26^-				
6589.7	(27^-)	542.3 *3*		6047.4	(25^-)				
6739.3		818.9 *3*		5920.4					
7071.6	$29^{(+)}$	1073.7 *3*		5997.9	28^-				

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Adopted Levels, Gammas (continued)

$\gamma(^{152}Ho)$ (continued)

E_i(level)	J_i^π	E_γ	E_f	J_f^π	E_i(level)	J_i^π	E_γ	E_f	J_f^π
7360.7	$30^{(+)}$	289.1 *3*	7071.6	$29^{(+)}$	10504.7	$35^{(-)}$	284.3 *3*	10220.5	$34^{(-)}$
7633.7	(29^-)	1044.0 *3*	6589.7	(27^-)			471.7 *3*	10032.9	$34^{(-)}$
8016.2	$30^{(+)}$	944.6 *3*	7071.6	$29^{(+)}$	10854.4		349.6 *3*	10504.7	$35^{(-)}$
8266.4		632.7 *3*	7633.7	(29^-)	11004.5		607.1 *3*	10397.4	
8281.1	$31^{(+)}$	265.2 *3*	8016.2	$30^{(+)}$	11295.0		897.6 *3*	10397.4	
		920.4 *3*	7360.7	$30^{(+)}$	11540.9	(37^-)	1036.3 *3*	10504.7	$35^{(-)}$
		1209.4 *3*	7071.6	$29^{(+)}$	11932.6	(38)	391.9 *3*	11540.9	(37^-)
8636.7	$32^{(+)}$	355.9 *3*	8281.1	$31^{(+)}$			1078.0 *3*	10854.4	
		620.3 *3*	8016.2	$30^{(+)}$	12451.6		519.0 *3*	11932.6	(38)
		1276.0 *3*	7360.7	$30^{(+)}$	12795.1		343.5 *3*	12451.6	
8641.9		1008.2 *3*	7633.7	(29^-)	12939.4		487.8 *3*	12451.6	
8929.5	$33^{(+)}$	292.9 *3*	8636.7	$32^{(+)}$	837.6+x		837.6 *3*	x	
		648.4 *3*	8281.1	$31^{(+)}$	1090.6+x		253.0 *3*	837.6+x	
8934.1		667.7 *3*	8266.4		1862.4+x		771.8 *3*	1090.6+x	
9260.5		618.6 *3*	8641.9		2399.1+x		1308.4 *3*	1090.6+x	
9549.0		619.5 *3*	8929.5	$33^{(+)}$	2489.2+x		90.1 *3*	2399.1+x	
9560.8		924.0 *3*	8636.7	$32^{(+)}$			626.9 *3*	1862.4+x	
9663.5	$33^{(+)}$	1026.7 *3*	8636.7	$32^{(+)}$			900.9 *3*	1588.3+x	
9915.6	$34^{(-)}$	252.0 *3*	9663.5	$33^{(+)}$	2934.8+x		445.6 *3*	2489.2+x	
		986.2 *3*	8929.5	$33^{(+)}$	3633.5+x		1144.3 *3*	2489.2+x	
10032.9	$34^{(-)}$	471.9 *3*	9560.8		3721.6+x		786.8 *3*	2934.8+x	
		1103.4 *3*	8929.5	$33^{(+)}$	3796.1+x		861.3 *3*	2934.8+x	
10220.5	$34^{(-)}$	1291.2 *3*	8929.5	$33^{(+)}$	4319.6+x		686.1 *3*	3633.5+x	
10221.2		557.7 *3*	9663.5	$33^{(+)}$	4362.2+x		728.7 *3*	3633.5+x	
10247.6		1610.9 *3*	8636.7	$32^{(+)}$	4945.0+x		1223.4 *3*	3721.6+x	
10397.4		1467.9 *3*	8929.5	$33^{(+)}$					

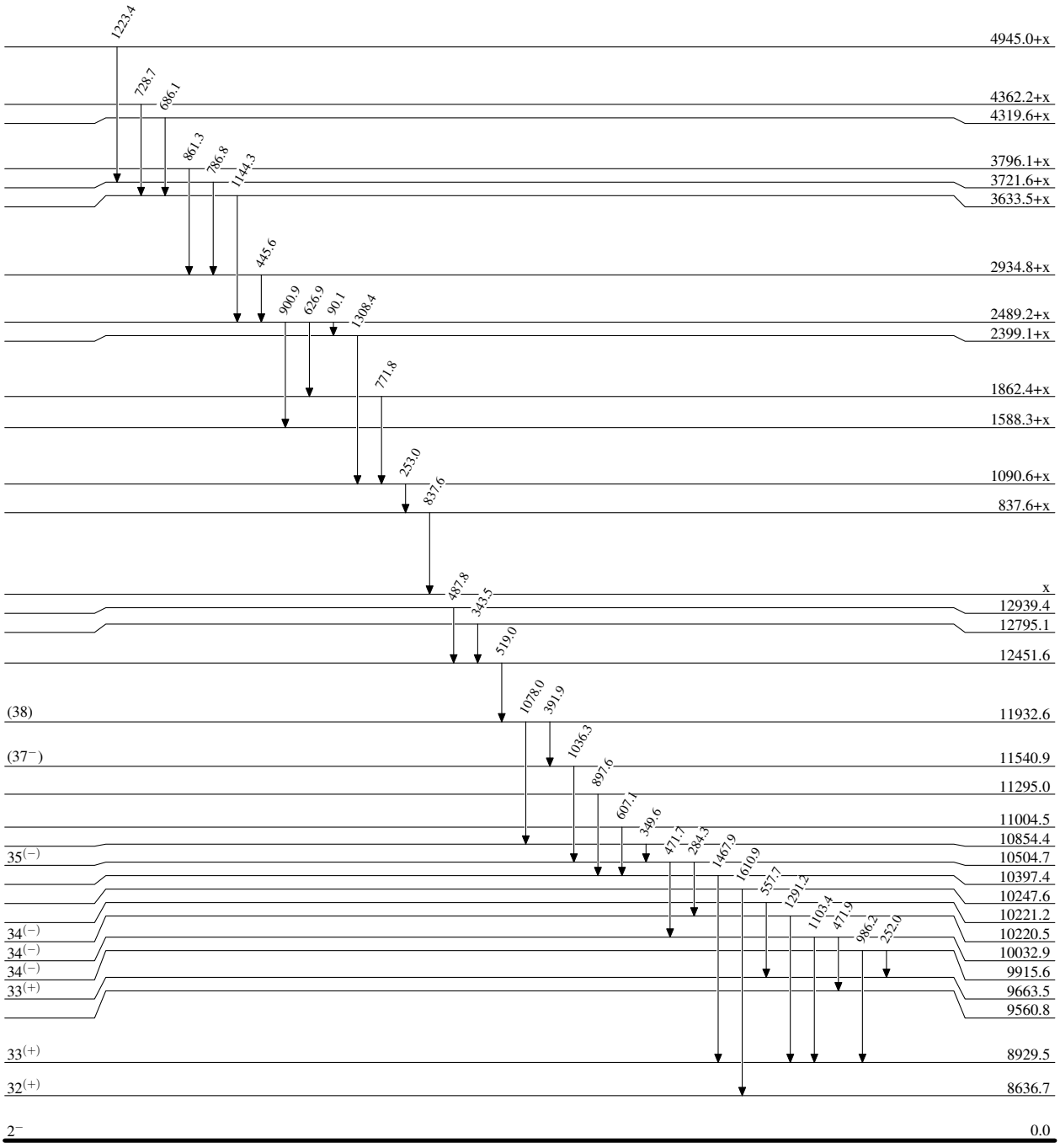
† From ^{152}Er ε decay.

‡ Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level

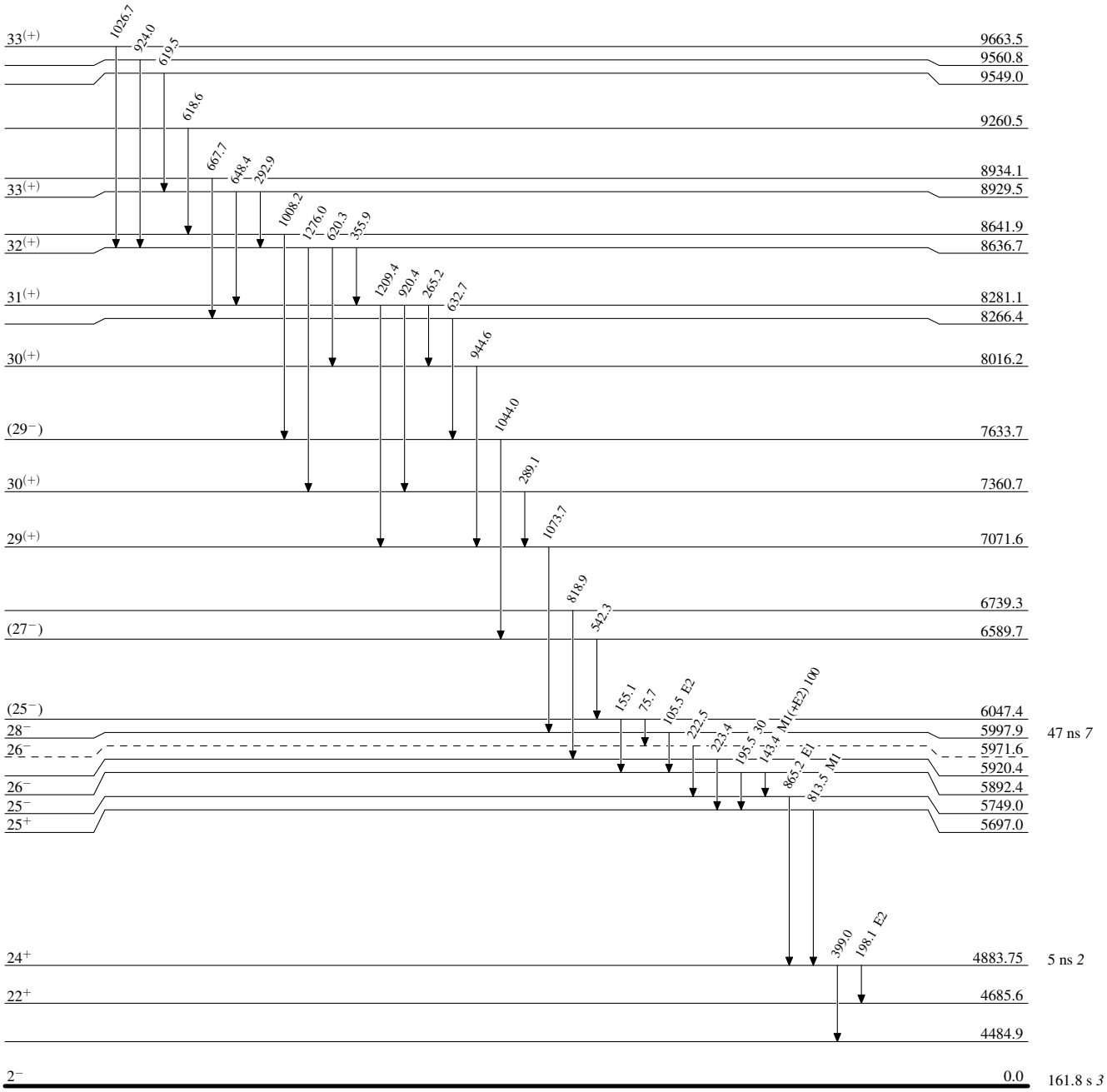


$^{152}_{67}Ho_{85}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level

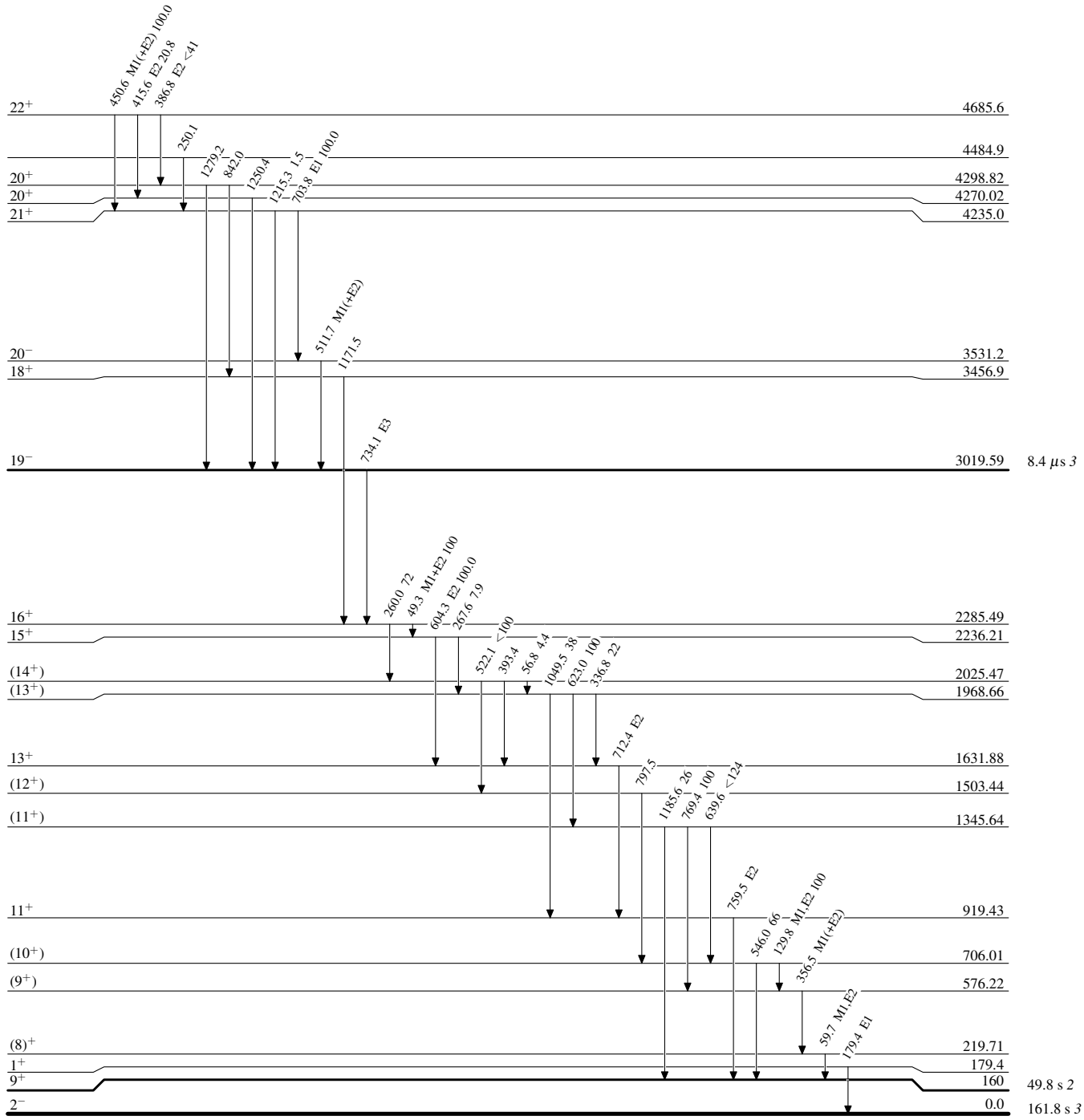


$^{152}_{67}Ho_{85}$

Adopted Levels, Gammas

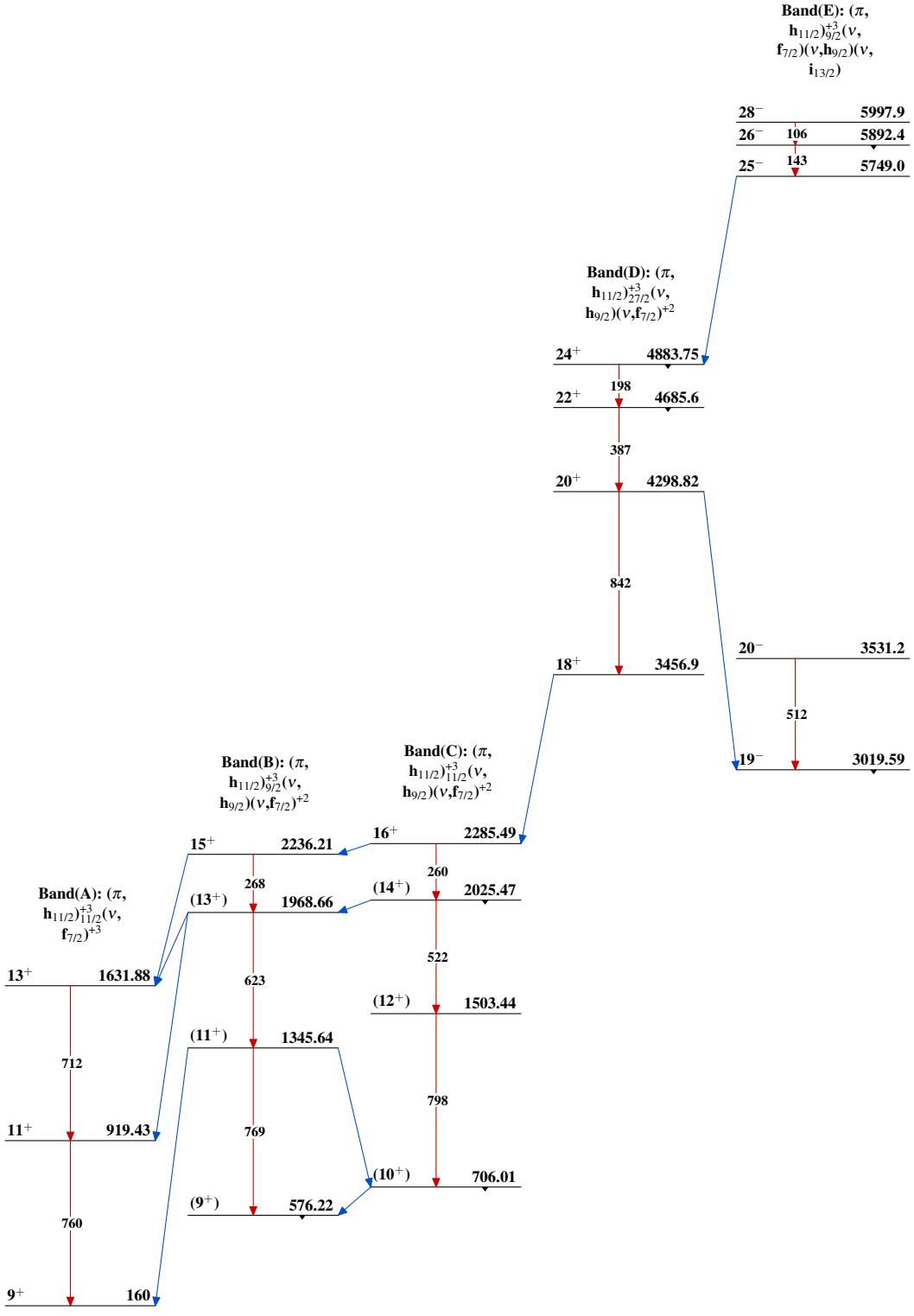
Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{152}_{67}Ho_{85}$

Adopted Levels, Gammas



$^{152}_{67}Ho_{85}$