^{150}Nd(^{18}O,4nγ) 1980Ya03,1997Ba63

History

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

Includes ^{154}Sm(^{14}C,4nγ).
1980Ya03: E=69.6 MeV. Measured Eγ, Iγ, $\gamma\gamma$.
1997Ba63: E=87 MeV. Measured γ, $\gamma\gamma$ using GASP array of Ge detectors.
1976Da10: ^{154}Sm(^{14}C,4nγ) E=62 MeV. Measured Eγ, Iγ, $\gamma\gamma$ coin, $\gamma\gamma$(t), $\gamma(\theta)$ for ground-state band.
1999Na20: ^{124}Sn(^{40}Ar,4nγ) E=160 MeV. Measured Eγ, Iγ, recoil-γ coin using fragment-mass analyzer. Deduced GDR parameters.
1985Si20 (also 1980Wi10): ^{159}Tb(^{14}N,^{9}Be) E=236 MeV. Measured (particle)(x ray) coin, fragment $\sigma(\theta)$.
1974De24: E=70 MeV. Measured Eγ, Iγ, $\gamma\gamma$ coin, deduced average multiplicity.

^{164}Er Levels

Nomenclature for quasiparticle labels:
A: ν5/2[642],α=+1/2.
B: ν5/2[642],α=−1/2.
E: ν5/2[523],α=+1/2.
F: ν5/2[523],α=−1/2.

E(level)[†]	J$^\pi$[#]	E(level)[†]	J$^\pi$[#]	T$_{1/2}$	E(level)[†]	J$^\pi$[#]
0.0[&]	0$^+$	2479.48[a] 15	(11$^+$)		3941.3[‡f] 15	15$^+$
91.37[&] 6	2$^+$	2519.1[b] 4	12$^+$		4017.9[a] 7	(17$^+$)
299.47[&] 9	4$^+$	2583.4[h] 3	10$^-$		4105.6[d] 7	18$^-$
614.38[&] 11	6$^+$	2631.18[d] 18	12$^-$		4121.1[&] 5	18$^+$
860.3[a]	2$^+$	2702.52[&] 20	14$^+$		4168.1[‡e] 15	16$^+$
946.4[a] 10	3$^+$	2733.1[a] 5	(12$^+$)		4344.4[i] 6	(18)
1024.58[&] 12	8$^+$	2800.40[i] 24	(12)		4345.6[b] 4	20$^+$
1058.1[a] 11	4$^+$	2815.15[c] 19	13$^-$		4364.1[a] 8	(18$^+$)
1197.62[a] 11	5$^+$	2822.2[g] 4	11$^-$		4384.9[c] 5	19$^-$
1358.4[a] 3	6$^+$	2874.73[b] 18	14$^+$		4411.8[‡f] 16	17$^+$
1518.01[&] 15	10$^+$	3027.3[a] 5	(13$^+$)		4590.1[a] 8	(19$^+$)
1545.15[a] 14	7$^+$	3066.6[d] 4	14$^-$		4671.9[‡e] 16	18$^+$
1664.1[c] 3	5$^-$	3079.1[h] 5	12$^-$		4702.0[d] 8	20$^-$
1744.46[d] 23	6$^-$	3244.3[i] 4	(14)		4868.3[&] 7	20$^+$
1744.69[a] 17	8$^+$	3263.03[b] 22	16$^+$		4946.9[‡f] 17	19$^+$
1845.49[c] 13	7$^-$	3266.8[a] 6	(14$^+$)		5000.0[b] 6	22$^+$
1964.29[d] 17	8$^-$	3280.96[c] 21	15$^-$		5018.2[c] 7	21$^-$
1977.15[a] 14	(9$^+$)	3352.0[g] 5	13$^-$		5230.6[a] 9	(21$^+$)
1985.14[g] 18	7$^-$	3376.2[‡e] 11	12$^+$	≥170[@] ns	5236.8[‡e] 18	20$^+$
2082.75[&] 17	12$^+$	3411.1[&] 4	16$^+$		5349.9[d] 9	22$^-$
2090.9[i] 3	(8)	3518.7[a] 6	(15$^+$)		5540.1[‡f] 18	21$^+$
2108.53[c] 15	9$^-$	3544.3[‡f] 14	13$^+$		5651.4[&] 8	(22$^+$)
2163.63[h] 19	8$^-$	3559.6[d] 5	16$^-$		5704.1[c] 11	23$^-$
2184.14[a] 18	(10$^+$)	3733.2[‡e] 14	14$^+$		5729.0[b] 8	24$^+$
2261.22[d] 17	10$^-$	3760.0[i] 5	(16)		5856.3[‡e] 19	22$^+$
2363.39[g] 21	9$^-$	3768.53[b] 22	18$^+$		6052.9[d] 13	24$^-$
2408.13[c] 19	11$^-$	3800.5[a] 6	(16$^+$)		6185.2[f] 19	23$^+$
2421.08[i] 23	(10)	3804.9[c] 5	17$^-$		6442.1[c] 15	25$^-$

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^{150}Nd(^{18}O,4nγ) 1980Ya03,1997Ba63 (continued)

^{164}Er Levels (continued)

E(level)†	Jπ#	E(level)†	Jπ#	E(level)†	Jπ#	E(level)†	Jπ#
6525.3[e] *20*	24^+	7613.2[f] *21*	27^+	8802.6[e] *23*	30^+	10410.0[b] *24*	34^+
6529.0[b] *13*	26^+	7640.9[d] *20*	28^-	9016.1[c] *23*	31^-	10515[d] *3*	34^-
6814.9[d] *17*	26^-	7997.9[e] *22*	28^+	9224.3[f] *24*	31^+	11049[c] *3*	35^-
6877.1[f] *20*	25^+	8095.1[c] *21*	29^-	9342.0[b] *22*	32^+	11549[b] *3*	36^+
7238.1[c] *18*	27^-	8338.0[b] *19*	30^+	9491.9[d] *24*	32^-		
7239.7[e] *21*	26^+	8395.3[f] *22*	29^+	9657.6[e] *25*	32^+		
7399.0[b] *16*	28^+	8533.9[d] *22*	30^-	10001.1[c] *25*	33^-		

† From least-squares fit to Eγ data. All levels above 6060 are from 1997Ba63.
‡ From 1997Ba63 only.
# As proposed by 1980Ya03 and 1997Ba63, based on previous assignments, $\gamma(\theta)$ data in 1976Da10, and band structures in these studies.
@ From γ(t) (1997Ba63). Value is 68 ns *2* in Adopted Levels.
& Band(A): $K^\pi=0^+$ g.s. band.
[a] Band(B): $K^\pi=2^+$ γ band.
[b] Band(C): AB band, based on 12^+.
[c] Band(D): AE, $K^\pi=5^-$ band,α=1.
[d] Band(d): AF, $K^\pi=5^-$ band,α=0.
[e] Band(E): $K^\pi=12^+$ band,α=0.
[f] Band(e): $K^\pi=12^+$ band,α=1.
[g] Band(F): $K^\pi=7^-$ band,α=1.
[h] Band(f): $K^\pi=7^-$ band,α=0.
[i] Band(G): band based on (8),α=0.

γ(^{164}Er)

A_2 and A_4 values are from 1976Da10.

E_γ†	I_γ†	E_i(level)	J_i^π	E_f	J_f^π	Mult.#	α@	Comments
80‡		1744.46	6^-	1664.1	5^-			
91.37 *6*	26 *2*	91.37	2^+	0.0	0^+	E2	4.14	Mult.: from Adopted Gammas.
101‡		1845.49	7^-	1744.46	6^-			
118.7 *2*	1.4 *6*	1964.29	8^-	1845.49	7^-			
139.5 *2*	1.6 *5*	1985.14	7^-	1845.49	7^-			
152.70 *12*	0.8 *3*	2261.22	10^-	2108.53	9^-			
168‡		3544.3	13^+	3376.2	12^+			
178.48 *6*	3.4 *2*	2163.63	8^-	1985.14	7^-			
189‡		3733.2	14^+	3544.3	13^+			
199.75 *9*	3.3 *3*	2363.39	9^-	2163.63	8^-			
208‡		3941.3	15^+	3733.2	14^+			
208.10 *6*	100	299.47	4^+	91.37	2^+	(E2)	0.221	A_2=+0.28 *2*; A_4=−0.19 *3*
219.9 *2*	2.0 *8*	1964.29	8^-	1744.46	6^-			
220.1 *2*	2.5 *6*	2583.4	10^-	2363.39	9^-			
227‡		4168.1	16^+	3941.3	15^+			
239.0 *3*	1.7 *4*	2822.2	11^-	2583.4	10^-			

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^{150}Nd(^{18}O,4nγ) 1980Ya03,1997Ba63 (continued)

γ(^{164}Er) (continued)

E_γ[†]	I_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[@]	Comments
240.5 *1*	4.4 *3*	1985.14	7^-	1744.46	6^-			
244[‡]		4411.8	17^+	4168.1	16^+			
251.2	<0.5	1197.62	5^+	946.4	3^+			
256.8 *4*	0.6 *3*	3079.1	12^-	2822.2	11^-			
260[‡]		4671.9	18^+	4411.8	17^+			
273[‡]		3352.0	13^-	3079.1	12^-			
275[‡]		4946.9	19^+	4671.9	18^+			
290[‡]		5236.8	20^+	4946.9	19^+			
296.93 *7*	4.7 *3*	2261.22	10^-	1964.29	8^-			
300.3	<0.5	1358.4	6^+	1058.1	4^+			
303[‡]		5540.1	21^+	5236.8	20^+			
314.95 *7*	88 *5*	614.38	6^+	299.47	4^+	(E2)	0.0596	A_2=+0.35 *2*; A_4=−0.11 *2*
316[‡]		5856.3	22^+	5540.1	21^+			
329[‡]		6185.2	23^+	5856.3	22^+			
330.2 *2*	1.3 *2*	2421.08	(10)	2090.9	(8)			
334.4 *4*	2.2 *9*	2519.1	12^+	2184.14	(10^+)			
340[‡]		6525.3	24^+	6185.2	23^+			
347.2 *2*	2.2 *3*	1545.15	7^+	1197.62	5^+			
352[‡]		6877.1	25^+	6525.3	24^+			
355.7 *4*	0.7 *3*	2874.73	14^+	2519.1	12^+			
357[‡]		3733.2	14^+	3376.2	12^+			
362[‡]		7239.7	26^+	6877.1	25^+			
369.96 *6*	4.6 *3*	2631.18	12^-	2261.22	10^-			
373[‡]		7613.2	27^+	7239.7	26^+			
379[‡]		2363.39	9^-	1985.14	7^-			
379.32 *7*	2.2 *2*	2800.40	(12)	2421.08	(10)			
385[‡]		7997.9	28^+	7613.2	27^+			
386.6 *4*	2.3 *9*	1744.69	8^+	1358.4	6^+			
388.4 *3*	1.1 *3*	3263.03	16^+	2874.73	14^+			
397[‡]		3941.3	15^+	3544.3	13^+			
397[‡]		8395.3	29^+	7997.9	28^+			
407[‡]		8802.6	30^+	8395.3	29^+			
407.1 *4*	1.3 *7*	2815.15	13^-	2408.13	11^-			
410.22 *7*	67 *5*	1024.58	8^+	614.38	6^+	(E2)	0.0279	A_2=+0.29 *2*; A_4=−0.10 *3*
419.9 *6*	0.2	2583.4	10^-	2163.63	8^-			
431.95 *7*	4.9 *4*	1977.15	(9^+)	1545.15	7^+			
435[‡]		4168.1	16^+	3733.2	14^+			
435.4 *3*	3.3 *5*	3066.6	14^-	2631.18	12^-			
436.5 *5*	2.7 *4*	2519.1	12^+	2082.75	12^+			
439.43 *8*	2.6 *3*	2184.14	(10^+)	1744.69	8^+			
443.9 *2*	2.9 *3*	2421.08	(10)	1977.15	(9^+)			
443.9 *2*	2.9 *3*	3244.3	(14)	2800.40	(12)			
458.5 *4*	1.7 *9*	2822.2	11^-	2363.39	9^-			
465.8 *1*	2.1 *3*	3280.96	15^-	2815.15	13^-			
470[‡]		4411.8	17^+	3941.3	15^+			
491.4 *4*	1.4 *6*	3518.7	(15^+)	3027.3	(13^+)			
493.0 *3*	1.3 *4*	3559.6	16^-	3066.6	14^-			
493.46 *10*	54 *3*	1518.01	10^+	1024.58	8^+	Q		A_2=+0.39 *4*; A_4=−0.06 *5*
496[‡]		3079.1	12^-	2583.4	10^-			
499.2 *4*	1.1 *6*	4017.9	(17^+)	3518.7	(15^+)			
502.33 *6*	3.3 *2*	2479.48	(11^+)	1977.15	(9^+)			

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^{150}Nd(^{18}O,4nγ) 1980Ya03,1997Ba63 (continued)

γ(^{164}Er) (continued)

E_γ[†]	I_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	Comments
504[‡]		4671.9	18^+	4168.1	16^+		
505.50 *6*	4.8 *4*	3768.53	18^+	3263.03	16^+	Q	A_2=+0.33 *11*; A_4=−0.17 *14*
515.7 *3*	1.1 *4*	3760.0	(16)	3244.3	(14)		
523.9 *4*	3.9 *11*	3804.9	17^-	3280.96	15^-		
529.7 *4*	0.9 *5*	3352.0	13^-	2822.2	11^-		
533.7[&] *3*	2.9[&] *2*	3266.8	(14^+)	2733.1	(12^+)		
533.7[&] *3*	2.9[&] *2*	3800.5	(16^+)	3266.8	(14^+)		
535[‡]		4946.9	19^+	4411.8	17^+		
546.0 *5*	1.5 *6*	2090.9	(8)	1545.15	7^+		
546.0 *5*	1.0 *4*	4105.6	18^-	3559.6	16^-		
547.2 *4*	2.2 *9*	1744.46	6^-	1197.62	5^+		
547.8 *4*	2.2 *9*	3027.3	(13^+)	2479.48	(11^+)		
549.0 *4*	2.3 *8*	2733.1	(12^+)	2184.14	(10^+)		
554[‡]		3376.2	12^+	2822.2	11^-		
560.50 *11*	5.1 *5*	3263.03	16^+	2702.52	14^+	(Q)	A_2=+0.34 *15*; A_4=−0.13 *18*
563.6 *5*	1.7 *9*	4364.1	(18^+)	3800.5	(16^+)		
564.73 *6*	33 *2*	2082.75	12^+	1518.01	10^+	Q	A_2=+0.29 *2*; A_4=−0.18 *5*
565[‡]		5236.8	20^+	4671.9	18^+		
572.2 *2*	1.1 *6*	4590.1	(19^+)	4017.9	(17^+)		
577.1 *3*	2.0 *5*	4345.6	20^+	3768.53	18^+		
578.4 *6*	1.0 *6*	3280.96	15^-	2702.52	14^+		
580.0 *2*	2.3 *7*	4384.9	19^-	3804.9	17^-		
583.2 *2*	2.1 *3*	1197.62	5^+	614.38	6^+		
584.4 *4*	1.0 *3*	4344.4	(18)	3760.0	(16)		
593[‡]		5540.1	21^+	4946.9	19^+		
596.4 *3*	0.7 *3*	4702.0	20^-	4105.6	18^-		
619.76 *11*	17 *2*	2702.52	14^+	2082.75	12^+	(Q)	A_2=+0.32 *7*; A_4=−0.08 *9*
620[‡]		5856.3	22^+	5236.8	20^+		
633.3 *4*	1.7 *9*	5018.2	21^-	4384.9	19^-		
640.5 *4*	1.1 *6*	5230.6	(21^+)	4590.1	(19^+)		
645[‡]		6185.2	23^+	5540.1	21^+		
647.9 *4*	0.7 *3*	5349.9	22^-	4702.0	20^-		
654.4 *4*	1.6 *3*	5000.0	22^+	4345.6	20^+		
666.2 *2*	1.6 *10*	2184.14	(10^+)	1518.01	10^+		
669[‡]		6525.3	24^+	5856.3	22^+		
685.9 *8*	1.7 *9*	5704.1	23^-	5018.2	21^-		
692[‡]		6877.1	25^+	6185.2	23^+		
703		6052.9	24^-	5349.9	22^-		
708.6 *3*	2.8 *6*	3411.1	16^+	2702.52	14^+		
710.0 *3*	2.6 *6*	4121.1	18^+	3411.1	16^+		
714[‡]		7239.7	26^+	6525.3	24^+		
720.1 *2*	1.8 *9*	1744.69	8^+	1024.58	8^+		
729.0 *5*	0.4 *2*	5729.0	24^+	5000.0	22^+		
732.4 *1*	2.6 *4*	2815.15	13^-	2082.75	12^+		
737[‡]		7613.2	27^+	6877.1	25^+		
738[‡]		6442.1	25^-	5704.1	23^-		
744.2 *3*	3.6 *13*	1358.4	6^+	614.38	6^+		
747.2 *4*	1.4 *4*	4868.3	20^+	4121.1	18^+		
758[‡]		7997.9	28^+	7239.7	26^+		
762[‡]		6814.9	26^-	6052.9	24^-		
782[‡]		8395.3	29^+	7613.2	27^+		
783.1 *4*	0.8 *3*	5651.4	(22^+)	4868.3	20^+		

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^{150}Nd(^{18}O,4nγ) 1980Ya03,1997Ba63 (continued)

γ(^{164}Er) (continued)

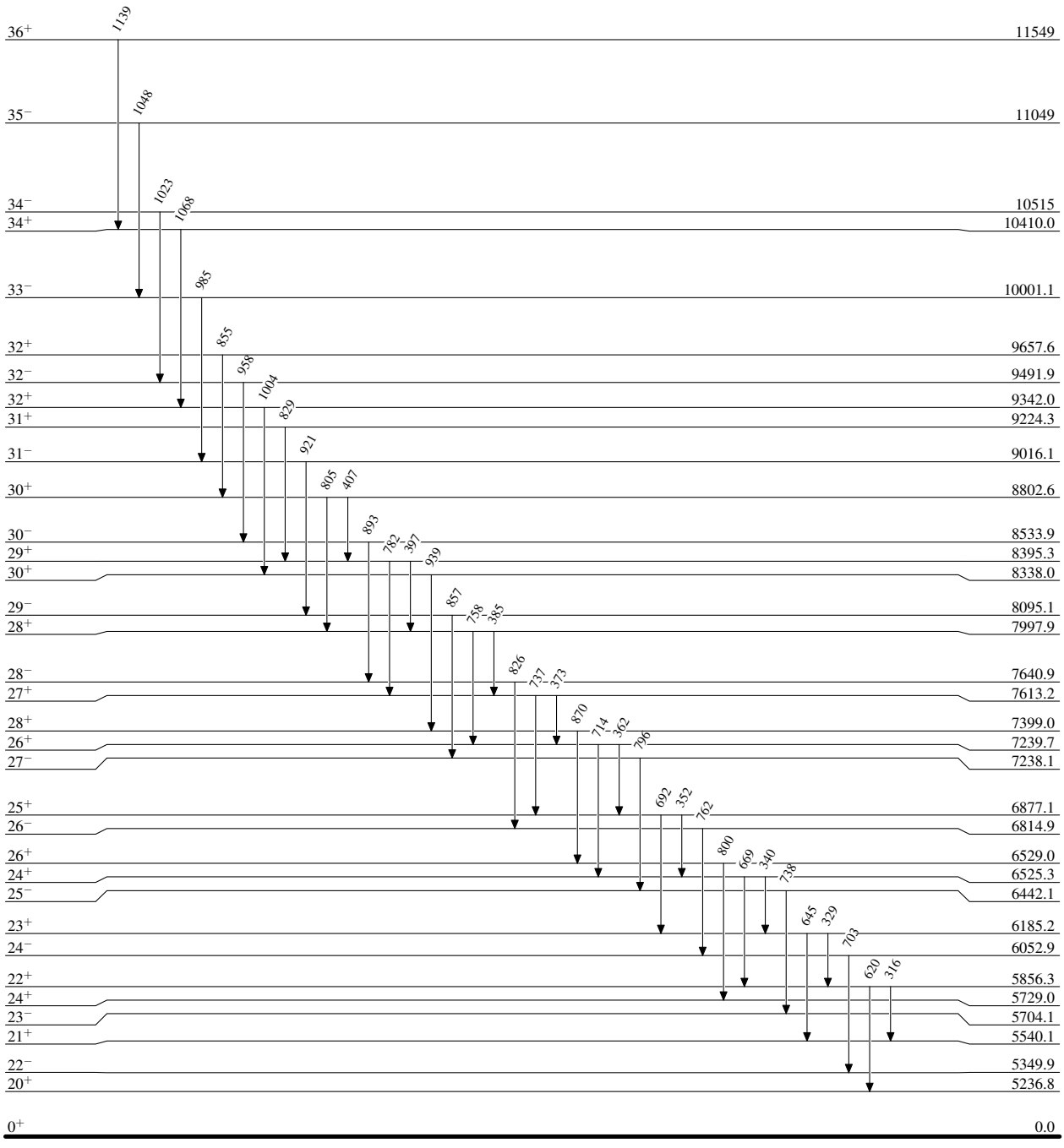
E_γ †	I_γ †	E_i(level)	J_i^π	E_f	J_f^π	E_γ †	I_γ †	E_i(level)	J_i^π	E_f	J_f^π
791.98 *7*	3.0 *2*	2874.73	14^+	2082.75	12^+	939‡		8338.0	30^+	7399.0	28^+
796‡		7238.1	27^-	6442.1	25^-	952.60 *7*	2.5 *3*	1977.15	(9^+)	1024.58	8^+
800‡		6529.0	26^+	5729.0	24^+	958‡		9491.9	32^-	8533.9	30^-
805‡		8802.6	30^+	7997.9	28^+	985‡		10001.1	33^-	9016.1	31^-
820.6 *2*	1.6 *3*	1845.49	7^-	1024.58	8^+	1001‡		2519.1	12^+	1518.01	10^+
826‡		7640.9	28^-	6814.9	26^-	1004‡		9342.0	32^+	8338.0	30^+
829‡		9224.3	31^+	8395.3	29^+	1023‡		10515	34^-	9491.9	32^-
855‡		9657.6	32^+	8802.6	30^+	1048‡		11049	35^-	10001.1	33^-
857‡		8095.1	29^-	7238.1	27^-	1049.9 *9*	0.9 *2*	1664.1	5^-	614.38	6^+
870‡		7399.0	28^+	6529.0	26^+	1068‡		10410.0	34^+	9342.0	32^+
890.12 *11*	2.7 *3*	2408.13	11^-	1518.01	10^+	1083.95 *9*	1.7 *2*	2108.53	9^-	1024.58	8^+
893‡		8533.9	30^-	7640.9	28^-	1139‡		11549	36^+	10410.0	34^+
898.14 *6*	6.4 *4*	1197.62	5^+	299.47	4^+	1231.10 *7*	4.2 *3*	1845.49	7^-	614.38	6^+
921‡		9016.1	31^-	8095.1	29^-	1364.6 *3*	3.3 *5*	1664.1	5^-	299.47	4^+
930.8 *4*	3.4 *11*	1545.15	7^+	614.38	6^+	1371‡		1985.14	7^-	614.38	6^+

† From 1980Ya03, unless otherwise stated.
‡ From 1997Ba63.
# $\Delta J=2$, Q (most likely E2) from $\gamma(\theta)$ data, unless otherwise stated. For low-energy transitions (<400 keV or so), $\Delta J=2$, Q transitions are assigned (E2), based on RUL for E2 and M2 transitions, assuming that the level half-lives are less than 20 ns or so.
@ 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.
& Multiply placed with undivided intensity.

^{150}Nd(^{18}O,4nγ) 1980Ya03,1997Ba63

Level Scheme

Intensities: Relative I_γ



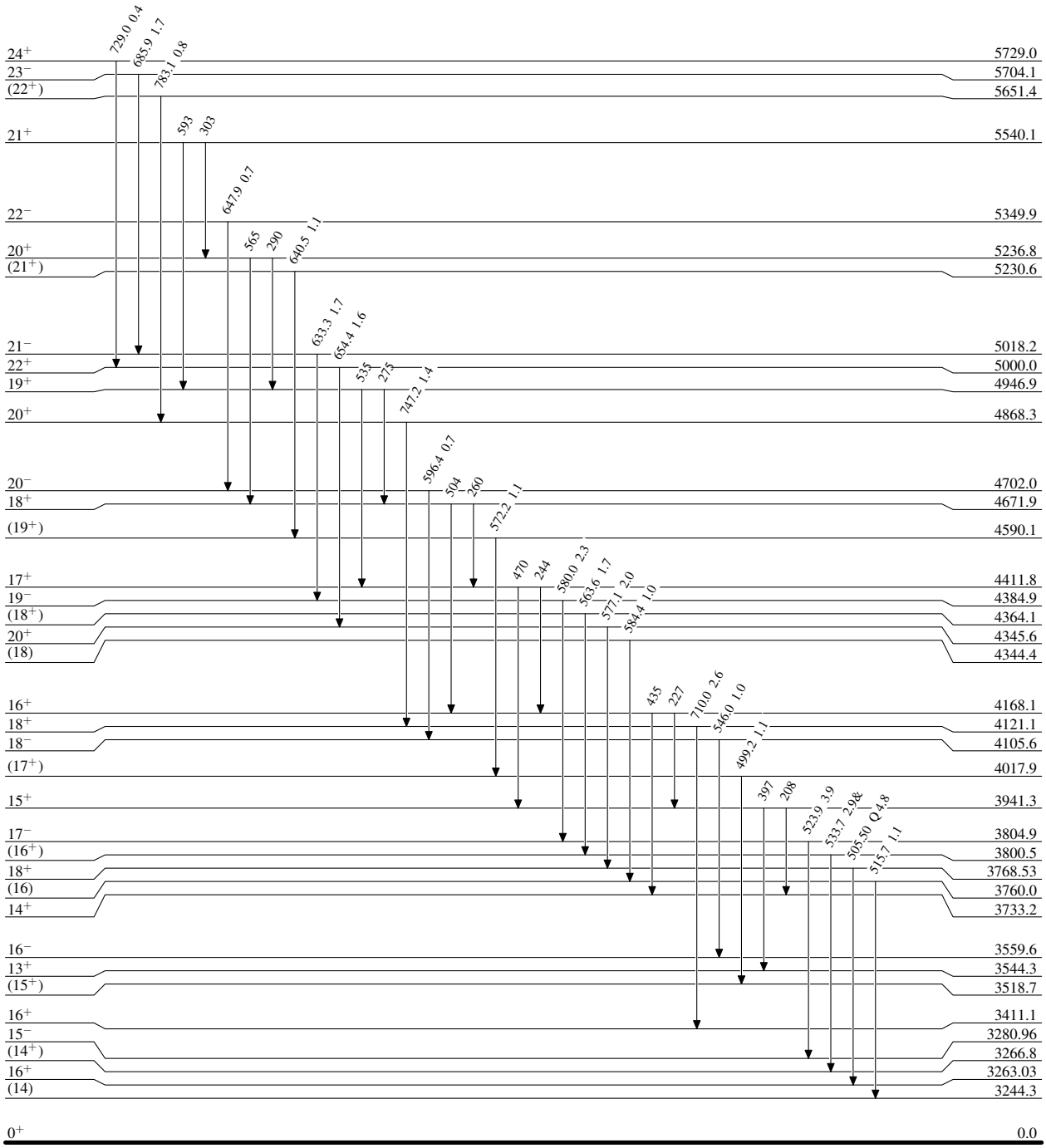
$^{164}_{68}Er_{96}$

^{150}Nd(^{18}O,4nγ) 1980Ya03,1997Ba63

Level Scheme (continued)

Intensities: Relative I_γ
& Multiply placed: undivided intensity given

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



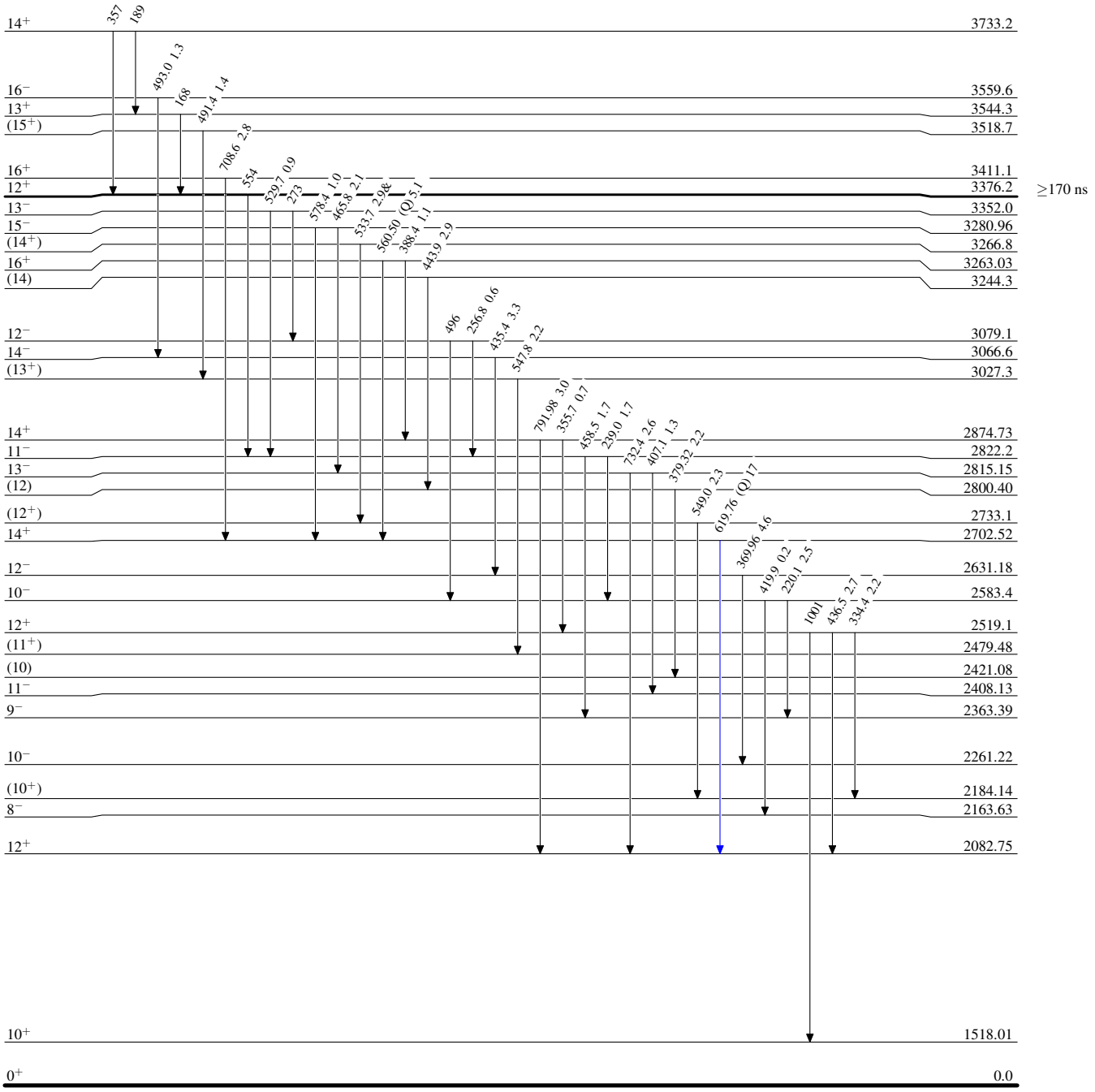
$^{164}_{68}Er_{96}$

^{150}Nd(^{18}O,4nγ) 1980Ya03,1997Ba63

Level Scheme (continued)

Intensities: Relative I_γ
& Multiply placed: undivided intensity given

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



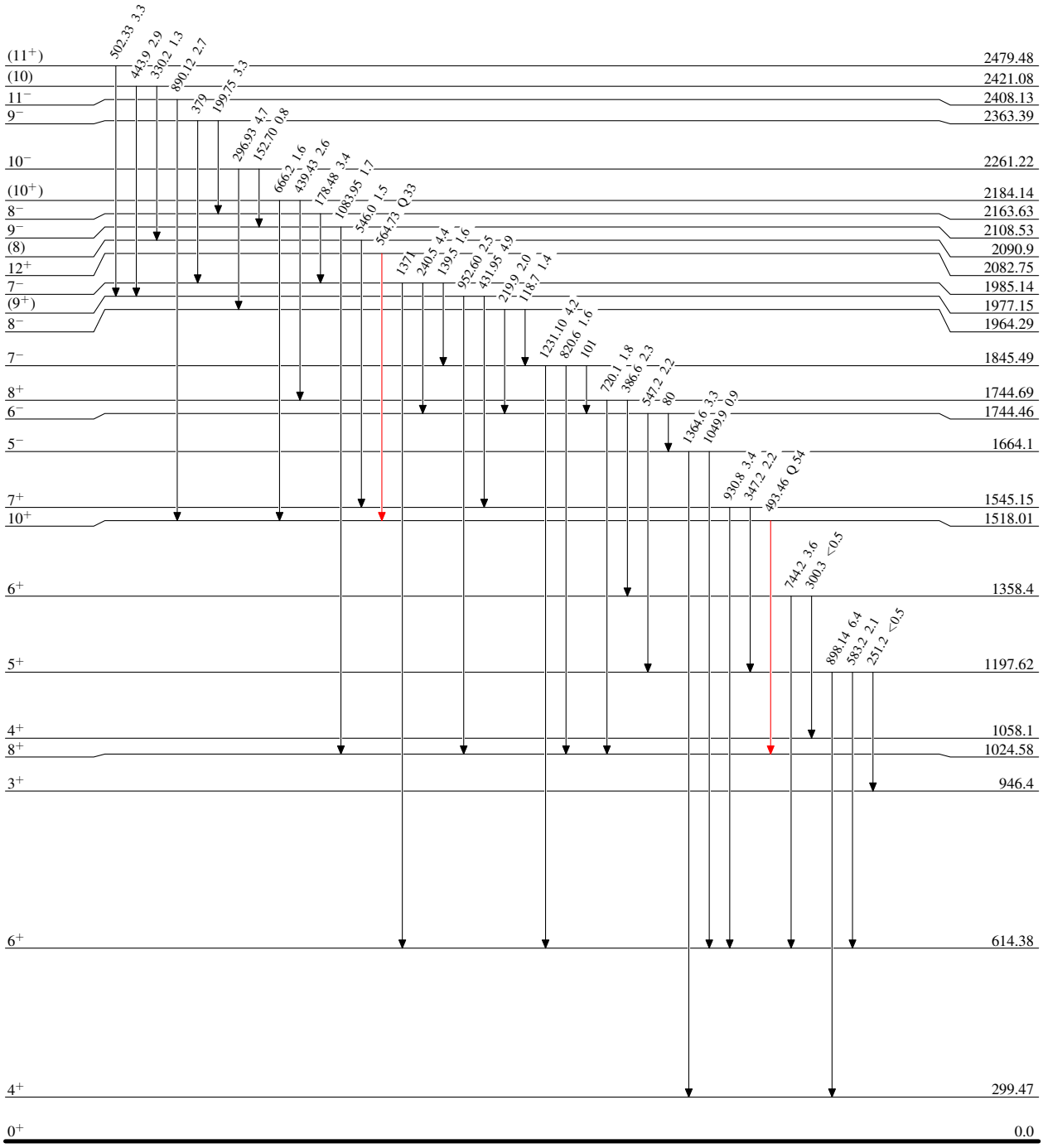
$^{164}_{68}Er_{96}$

^{150}Nd(^{18}O,4nγ) 1980Ya03,1997Ba63

Level Scheme (continued)

Intensities: Relative I_γ
& Multiply placed: undivided intensity given

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

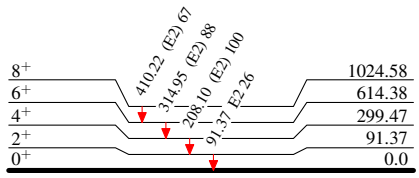


$^{164}_{68}Er_{96}$

^{150}Nd(^{18}O,4nγ) 1980Ya03,1997Ba63

Level Scheme (continued)

Intensities: Relative I_γ
& Multiply placed: undivided intensity given

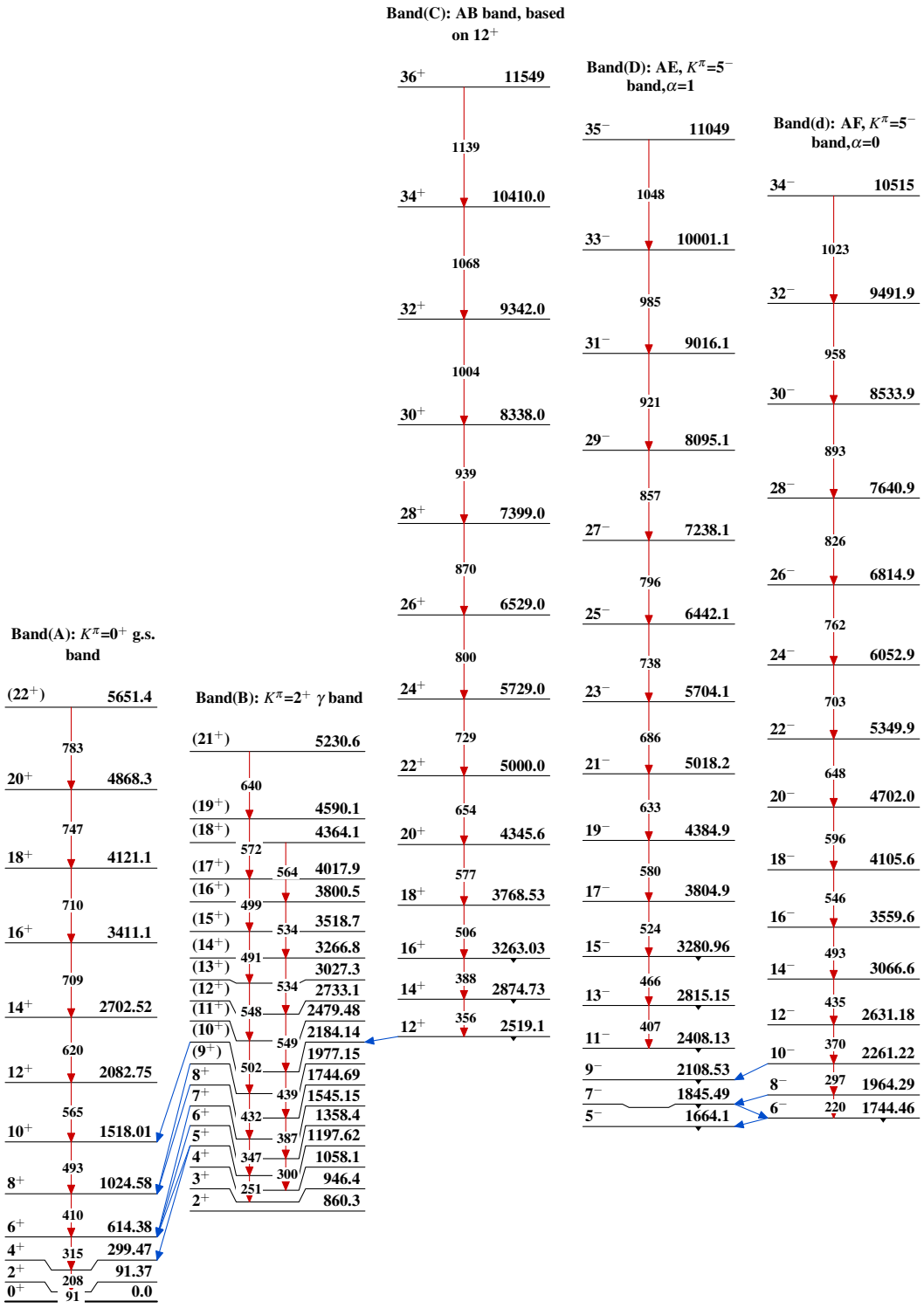


$^{164}_{68}Er_{96}$

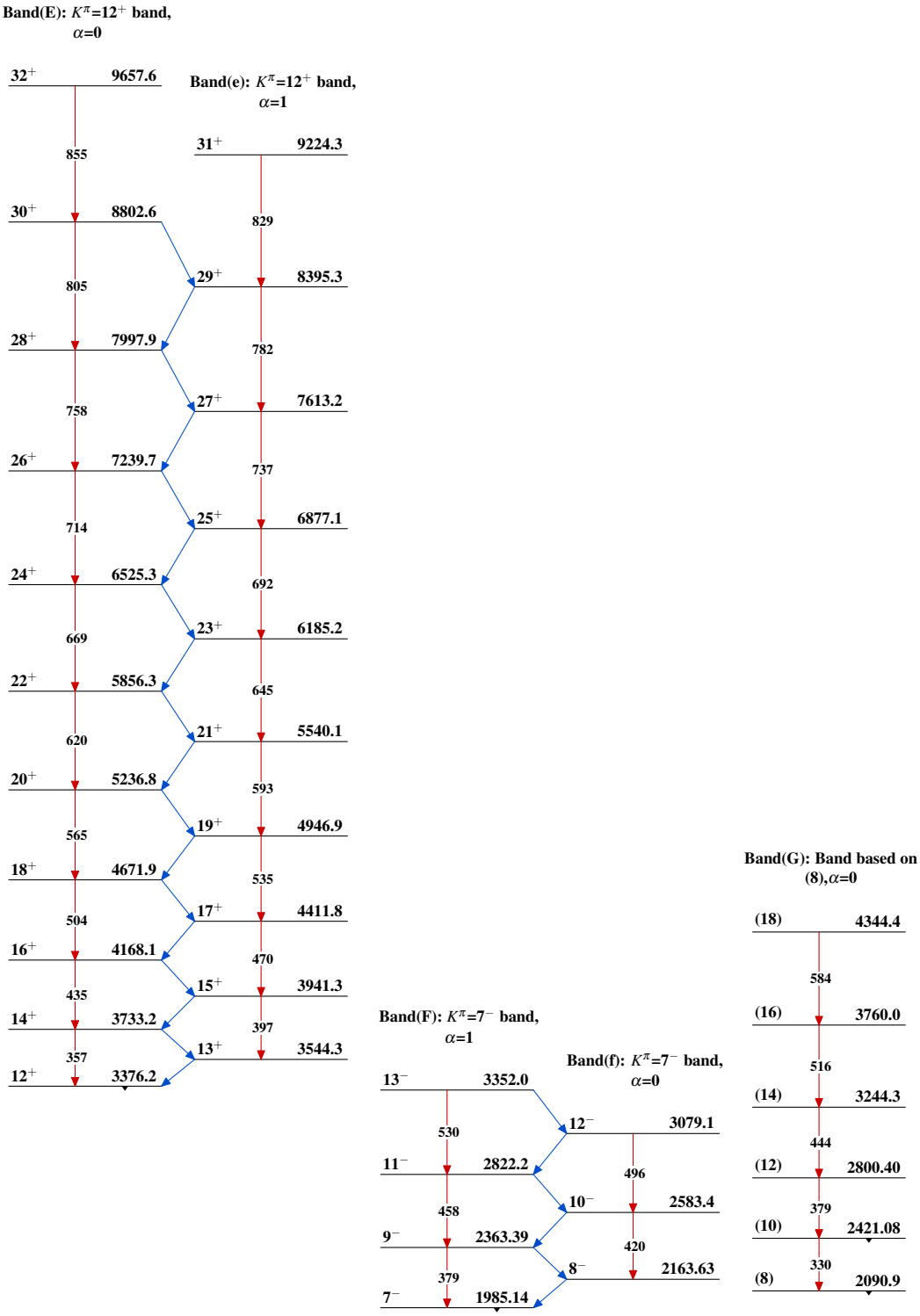
Legend

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

^{150}Nd(^{18}O,4nγ) 1980Ya03,1997Ba63



^{150}Nd(^{18}O,4nγ) 1980Ya03,1997Ba63 (continued)



$^{164}_{68}Er_{96}$