^{167}Er(n,n′γ) 1979Bo44

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 191,1 (2023)	22-Aug-2023

1979Bo44: E(n)=fast neutrons from a reactor of Latvian Academy of Sciences. Measured Eγ, Iγ in the 50-1200 keV range with the observation of 90 γ rays using a Ge(Li) detector and 95.2% enriched ^{167}Er target. The γ rays were placed between ten rotational bands. Deduced population intensities of levels and a comparison made with the level population in ^{166}Er(n,γ),E=thermal reaction. In the ν7/2[633] and ν1/2[521] rotational bands, levels were reported up to 19/2, and significant perturbation of the ν5/2[642] band was observed.

Other:

1976Ga33: (n,n′γ),E=14.7 MeV and ^{168}Er(n,2nγ),E=14.7 MeV; measured half-life of the 2.23-s isomer at 208 keV from γ-ray decay curve obtained using a scintillation detector.

^{167}Er Levels

E(level)[†]	Jπ[‡]	$T_{1/2}$	Comments
0.0[#]	7/2+		
79.33[#] *7*	9/2+		
177.96[#] *7*	11/2+		
207.76[@] *8*	1/2−	2.23 s *12*	$T_{1/2}$: from γ-ray decay curve using scintillation detector, with the isomer populated in ^{167}Er(n,n′γ) and ^{168}Er(n,2nγ) at E(n)=14.7 MeV. $T_{1/2}$=2.269 s *6* in the Adopted Levels.
265.35[@] *17*	3/2−		
282.31[@] *18*	5/2−		
294.79[#] *9*	13/2+		
346.66[&] *13*	5/2−		
413.85[@] *18*	7/2−		
430.35[&] *14*	7/2−		
434.20[#] *15*	15/2+		
442.62[@] *19*	9/2−		
531.51[d] *10*	3/2+		
536.03[&] *15*	9/2−		
573.74[d] *9*	5/2+		
587.25[#] *16*	17/2+		
640.04[d] *12*	7/2+		
645.82[@] *23*	11/2−		
662.4[&] *3*	11/2−		
668.10[a] *14*	5/2−		
683.92[@] *24*	13/2−		
710.84[e] *13*	11/2+		
711.12[d] *14*	9/2+		
745.35[a] *16*	7/2−		
752.54[b] *16*	3/2−		
764.5[c] *4*	1/2−		
772.3[#] *5*	19/2+		
790.97[d] *21*	11/2+		
803.1[c] *4*	3/2−		
809.9?[&] *6*	13/2−		
810.53[f] *11*	5/2+		

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^{167}Er(n,n′γ) 1979Bo44 (continued)

^{167}Er Levels (continued)

E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡
812.96[b] 23	5/2−	895.34[b] 23	7/2−	1042.3[c] 3	9/2−	1171.1 8	
828.21[e] 15	13/2+	933.13[f] 19	9/2+	1052.9[g] 5	11/2−	1216.7?[g] 5	13/2−
845.6[a] 3	9/2−	943.7[c] 3	7/2−	1058.19[f] 18	11/2+	1337.8[@] 6	19/2−
857.0[c] 3	5/2−	955.2[@] 4	15/2−	1086.2 4			
873.06[f] 14	7/2+	965.93[e] 19	15/2+	1110.2[f] 4	13/2+		
878.2?[d] 4	(13/2+)	999.3[@] 3	17/2−	1125.8?[e] 4	17/2+		

† From a least-squares fit to Eγ data.
‡ From 1979Bo44, based on rotational-band assignments from γ-ray energy fits and intensity patterns in ^{167}Er(n,γ) E=thermal and ^{167}Er(n,n′γ).
# Band(A): ν7/2[633].
@ Band(B): ν1/2[521].
& Band(C): ν5/2[512].
a Band(D): ν5/2[523].
b Band(E): ν3/2[521].
c Band(F): ν1/2[510].
d Band(G): 3/2+, γ-vibrational band.
e Band(H): 11/2+, γ-vibrational band.
f Band(I): ν5/2[642]. Significant perturbation of the ν5/2[642] band (1979Bo44).
g Band(J): ν11/2[505].

γ(^{167}Er)

Eγ	Iγ	Ei(level)	Jiπ	Ef	Jfπ	Mult.	Comments
(57.07†)		265.35	3/2−	207.76	1/2−		
(73.78†)		282.31	5/2−	207.76	1/2−		
79.3 1	40 12	79.33	9/2+	0.0	7/2+		Iγ: uncertain because of intense overlapping components from ^{166}Er and ^{168}Er.
(83.47†)		430.35	7/2−	346.66	5/2−		Eγ: transition masked by Pb x rays.
98.63 8	58 11	177.96	11/2+	79.33	9/2+		
105.75 10	12.2 20	536.03	9/2−	430.35	7/2−		
116.77 8	27.2 27	294.79	13/2+	177.96	11/2+		
127.0 3	7.4 12	662.4	11/2−	536.03	9/2−		
131.52 10	18.4 15	413.85	7/2−	282.31	5/2−		
(139.50†)	5.1 7	434.20	15/2+	294.79	13/2+		Eγ: transition masked by strong background line resulting from (n,n′γ) on germanium; Eγ is from Adopted Gammas, Iγ from Iγ(256.2γ) and adopted branching from 434.4 level.
148.43 8	20.6 15	413.85	7/2−	265.35	3/2−		
153.1 3	1.8 5	587.25	17/2+	434.20	15/2+		
160.37 8	37.3 21	442.62	9/2−	282.31	5/2−		
x166.7 3	1.9 5						
177.92 8	15.1 13	177.96	11/2+	0.0	7/2+		
189.3 3	3.9 4	536.03	9/2−	346.66	5/2−		
203.2 2	6.3 5	645.82	11/2−	442.62	9/2−		
207.72 8	100 5	207.76	1/2−	0.0	7/2+	[E3]	Mult.: E3 in the Adopted dataset.
215.48 15	13.1 8	294.79	13/2+	79.33	9/2+		
232.0 2	11.5 7	645.82	11/2−	413.85	7/2−		
238.0 3	1.0 3	668.10	5/2−	430.35	7/2−		

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^{167}Er(n,n′γ) 1979Bo44 (continued)

γ(^{167}Er) (continued)

E_γ	I_γ	E_i(level)	J_i^π	E_f	J_f^π	Comments
241.32 *15*	10.5 *7*	683.92	13/2$^-$	442.62	9/2$^-$	
256.25 *15*	8.3 *6*	434.20	15/2$^+$	177.96	11/2$^+$	
[x]265.2 *4*	0.5 *3*					
[x]276.4 *2*	3.2 *5*					
292.45 *14*	3.5 *4*	587.25	17/2$^+$	294.79	13/2$^+$	
[x]303.2 *3*	1.0 *3*					
309.35 *24*	3.2 *4*	955.2	15/2$^-$	645.82	11/2$^-$	
315.38[#] *16*	5.7[#] *5*	745.35	7/2$^-$	430.35	7/2$^-$	I_γ: 4.0 *13* can be deduced from Iγ(315 doublet)=5.7 *5*, I(399γ)=4.9 *5* and adopted Iγ(315.4γ)/Iγ(398.8γ)=0.81 *24*; however, the 399γ in (n,n′γ) is also complex, so this gives only an upper limit.
315.38[#] *16*	5.7[#] *5*	999.3	17/2$^-$	683.92	13/2$^-$	I_γ: see comment for 315γ from 745 level.
321.33 *9*	6.7 *6*	668.10	5/2$^-$	346.66	5/2$^-$	
332.0[@] *5*	0.6 *3*	745.35	7/2$^-$	413.85	7/2$^-$	Tentatively placed by evaluator, consistent with the Adopted Gammas.
338.1[#] *4*	1.1[#] *3*	772.3	19/2$^+$	434.20	15/2$^+$	
338.1[#@] *4*	1.1[#] *3*	1337.8	19/2$^-$	999.3	17/2$^-$	
342.1 *4*	3.2 *6*	1052.9	11/2$^-$	710.84	11/2$^+$	
346.71 *15*	88.0 *30*	346.66	5/2$^-$	0.0	7/2$^+$	
350.9 *4*	3.3 *6*	430.35	7/2$^-$	79.33	9/2$^+$	
358.0 *4*	4.0 *4*	536.03	9/2$^-$	177.96	11/2$^+$	
[x]363.7 *4*	0.9 *3*					
366.6 *4*	1.4 *3*	662.4	11/2$^-$	294.79	13/2$^+$	
[x]370.0 *4*	1.6 *4*					
375.7[@] *5*	0.6 *3*	809.9?	13/2$^-$	434.20	15/2$^+$	Tentative placement from Table 2 in 1979Bo44, unplaced in authors′ Table 1.
382.6 *4*	1.2 *3*	1337.8	19/2$^-$	955.2	15/2$^-$	
386.6 *4*	0.8 *3*	668.10	5/2$^-$	282.31	5/2$^-$	
388.5[@] *4*	0.9 *3*	1216.7?	13/2$^-$	828.21	13/2$^+$	
398.85[‡] *10*	4.9 *5*	745.35	7/2$^-$	346.66	5/2$^-$	
402.85 *14*	2.1 *4*	668.10	5/2$^-$	265.35	3/2$^-$	
415.24[‡] *22*	3.9 *5*	845.6	9/2$^-$	430.35	7/2$^-$	
[x]422.0 *3*	≈0.6					I_γ: 1979Bo44 attribute ≈50% of intensity to background line from (n,n′γ) on germanium; total Iγ=1.2 *3*.
430.8 *2*	2.6 *4*	430.35	7/2$^-$	0.0	7/2$^+$	
444.0[@] *2*	≈1.0	857.0	5/2$^-$	413.85	7/2$^-$	I_γ: 1979Bo44 attribute ≈50% of intensity to background line from (n,n′γ) on germanium; total Iγ=1.9 *4*.
453.1 *2*	1.3 *3*	895.34	7/2$^-$	442.62	9/2$^-$	Placement from Table 2 in 1979Bo44, unplaced in authors′ Table 1.
456.4[#] *3*	1.0[#] *3*	536.03	9/2$^-$	79.33	9/2$^+$	
456.4[#] *3*	1.0[#] *3*	803.1	3/2$^-$	346.66	5/2$^-$	
462.4[‡] *2*	2.9 *4*	745.35	7/2$^-$	282.31	5/2$^-$	
469.4 *4*	0.9 *3*	752.54	3/2$^-$	282.31	5/2$^-$	Placement from Table 1 in 1979Bo44, not shown in authors′ Table 2.
481.13 *20*	4.0 *4*	895.34	7/2$^-$	413.85	7/2$^-$	
487.7 *3*	1.7 *4*	752.54	3/2$^-$	265.35	3/2$^-$	
494.50 *14*	9.0 *6*	573.74	5/2$^+$	79.33	9/2$^+$	Iγ=8.0 in Table 2 of 1979Bo44.
499.2 *3*	≈2.4	764.5	1/2$^-$	265.35	3/2$^-$	I_γ: 1979Bo44 attribute ≈30% of intensity to background line from (n,n′γ) on germanium; total Iγ=3.4 *4*.
[x]525.9 *4*	1.0 *3*					
531.51[‡] *10*	31.3 *15*	531.51	3/2$^+$	0.0	7/2$^+$	
[x]542.4 *2*	≈0.7					I_γ: 1979Bo44 attribute ≈50% of intensity to ^{168}Er; total Iγ=1.4 *3*.
544.65 *15*	3.3 *5*	752.54	3/2$^-$	207.76	1/2$^-$	

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^{167}Er(n,n′γ) 1979Bo44 (continued)

γ(^{167}Er) (continued)

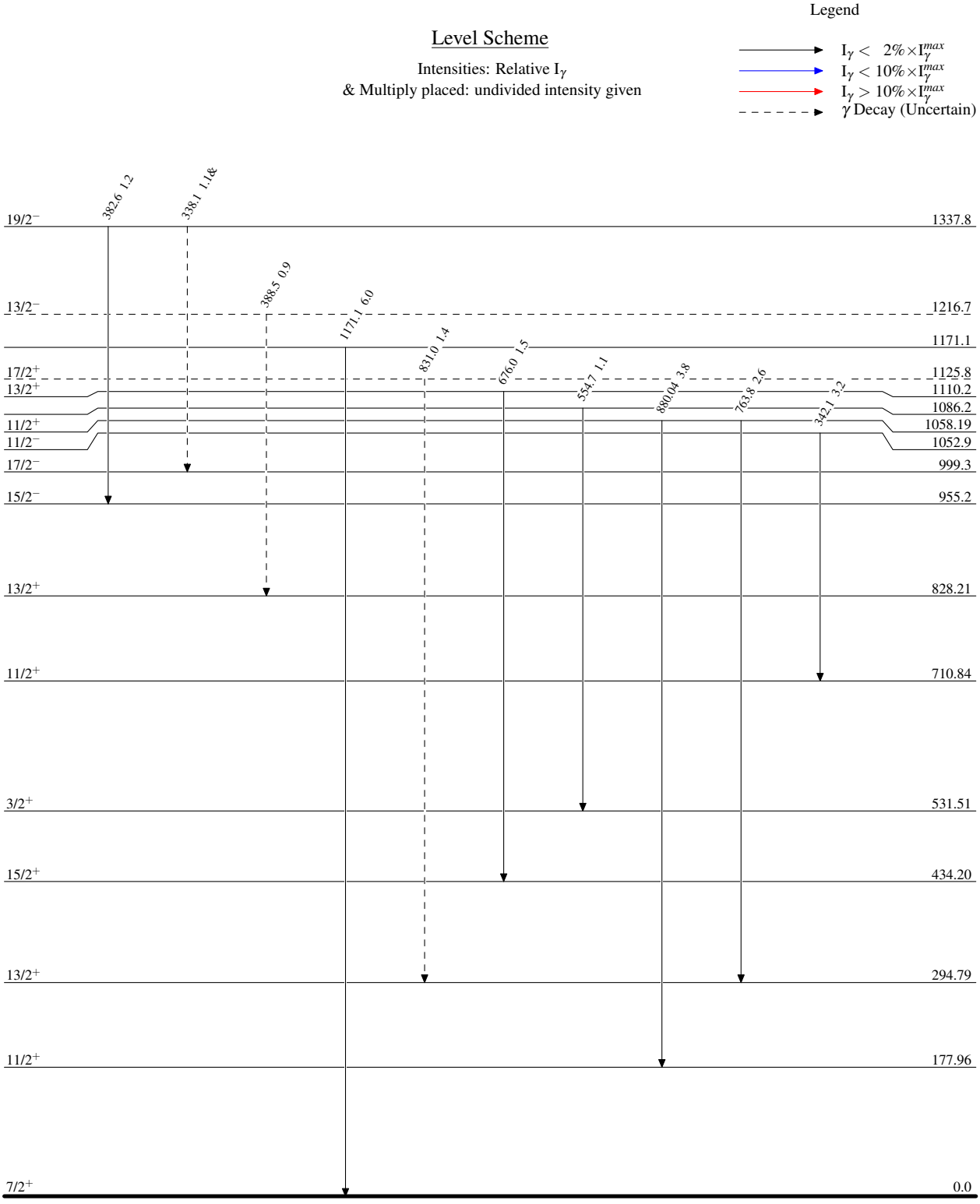
E_γ	I_γ	E_i(level)	J_i^π	E_f	J_f^π	Comments
547.61 *15*	3.3 *5*	812.96	5/2$^-$	265.35	3/2$^-$	
554.7 *3*	1.1 *3*	1086.2		531.51	3/2$^+$	
560.67 *15*	12.3 *7*	640.04	7/2$^+$	79.33	9/2$^+$	Iγ=11.5 in Table 2 of 1979Bo44.
573.70 *10*	18.1 *9*	573.74	5/2$^+$	0.0	7/2$^+$	
583.4 *3*	1.4 *5*	878.2?	(13/2$^+$)	294.79	13/2$^+$	
591.6‡ *2*	4.1 *5*	857.0	5/2$^-$	265.35	3/2$^-$	
600.4@ *4*	0.8 *4*	1042.3	9/2$^-$	442.62	9/2$^-$	
613.0# *2*	2.7# *4*	790.97	11/2$^+$	177.96	11/2$^+$	
613.0# *2*	2.7# *4*	895.34	7/2$^-$	282.31	5/2$^-$	
x623.5 *2*	1.3 *3*					
628.1#@ *3*	2.8# *6*	895.34	7/2$^-$	265.35	3/2$^-$	
628.1# *3*	2.8# *6*	1042.3	9/2$^-$	413.85	7/2$^-$	
631.79 *12*	≈10.2	711.12	9/2$^+$	79.33	9/2$^+$	I_γ: 1979Bo44 attribute ≈20% of intensity to ^{168}Er; total Iγ=12.7 *9*.
640.08 *16*	5.3 *4*	640.04	7/2$^+$	0.0	7/2$^+$	
x646.41‡ *20*	5.2 *4*					
650.23 *20*	4.1 *4*	828.21	13/2$^+$	177.96	11/2$^+$	
661.37 *20*	5.3 *5*	943.7	7/2$^-$	282.31	5/2$^-$	
670.9 *2*	2.2 *4*	965.93	15/2$^+$	294.79	13/2$^+$	
676.0 *3*	1.5 *3*	1110.2	13/2$^+$	434.20	15/2$^+$	
710.84 *13*	16.7 *11*	710.84	11/2$^+$	0.0	7/2$^+$	
x727.6 *2*	2.6 *4*					
x741.65 *25*	≈0.7					I_γ: 1979Bo44 attribute ≈80% of intensity to background line from ^{168}Er from (n,γ); total Iγ=3.3 *4*.
748.90 *19*	5.4 *5*	828.21	13/2$^+$	79.33	9/2$^+$	Iγ=5.0 in Table 2 of 1979Bo44.
755.16 *18*	4.3 *4*	933.13	9/2$^+$	177.96	11/2$^+$	
763.8 *3*	2.6 *4*	1058.19	11/2$^+$	294.79	13/2$^+$	
x779.5 *3*	1.4 *3*					
788.5 *3*	2.0 *4*	965.93	15/2$^+$	177.96	11/2$^+$	
793.59 *18*	4.5 *4*	873.06	7/2$^+$	79.33	9/2$^+$	
810.53 *11*	8.6 *6*	810.53	5/2$^+$	0.0	7/2$^+$	
831.0@ *3*	1.4 *3*	1125.8?	17/2$^+$	294.79	13/2$^+$	
853.53 *15*	≈2.5	933.13	9/2$^+$	79.33	9/2$^+$	I_γ: 1979Bo44 attribute ≈50% of intensity to ^{168}Er; total Iγ=5.0 *5*.
873.24 *20*	3.6 *4*	873.06	7/2$^+$	0.0	7/2$^+$	
880.04 *20*	3.8 *4*	1058.19	11/2$^+$	177.96	11/2$^+$	Iγ=2.8 in Table 2 of 1979Bo44.
1171.1‡ *8*	6.0 *8*	1171.1		0.0	7/2$^+$	

† Rounded value from the Adopted Gammas.
‡ Complex line.
# Multiply placed with undivided intensity.
@ Placement of transition in the level scheme is uncertain.
x γ ray not placed in level scheme.

^{167}Er(n,n′γ) 1979Bo44

Level Scheme

Intensities: Relative I_γ
& Multiply placed: undivided intensity given



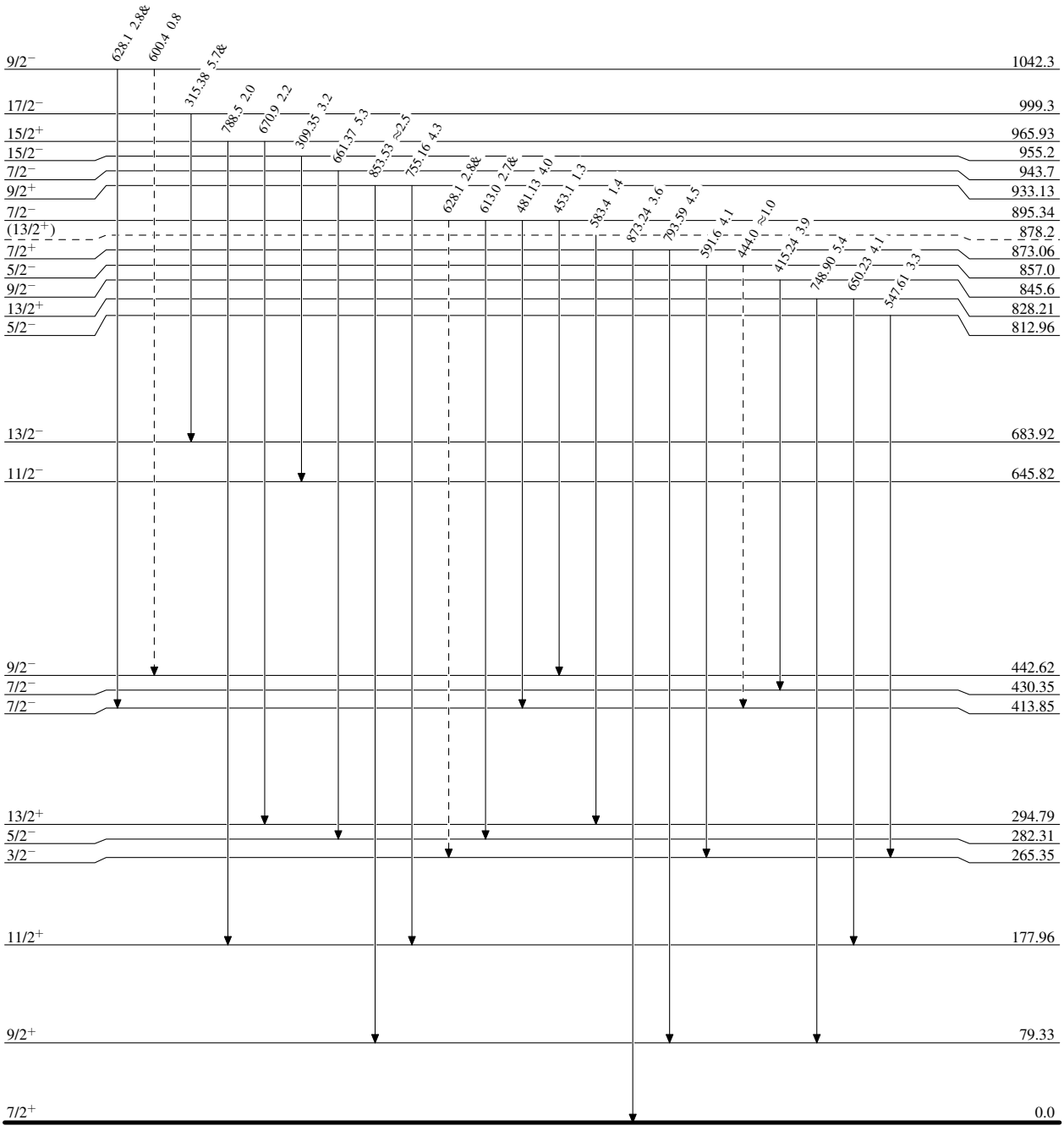
$^{167}_{68}Er_{99}$

^{167}Er(n,n′γ) 1979Bo44

Level Scheme (continued)

Intensities: Relative I_γ
& Multiply placed: undivided intensity given

Legend
- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- γ Decay (Uncertain)



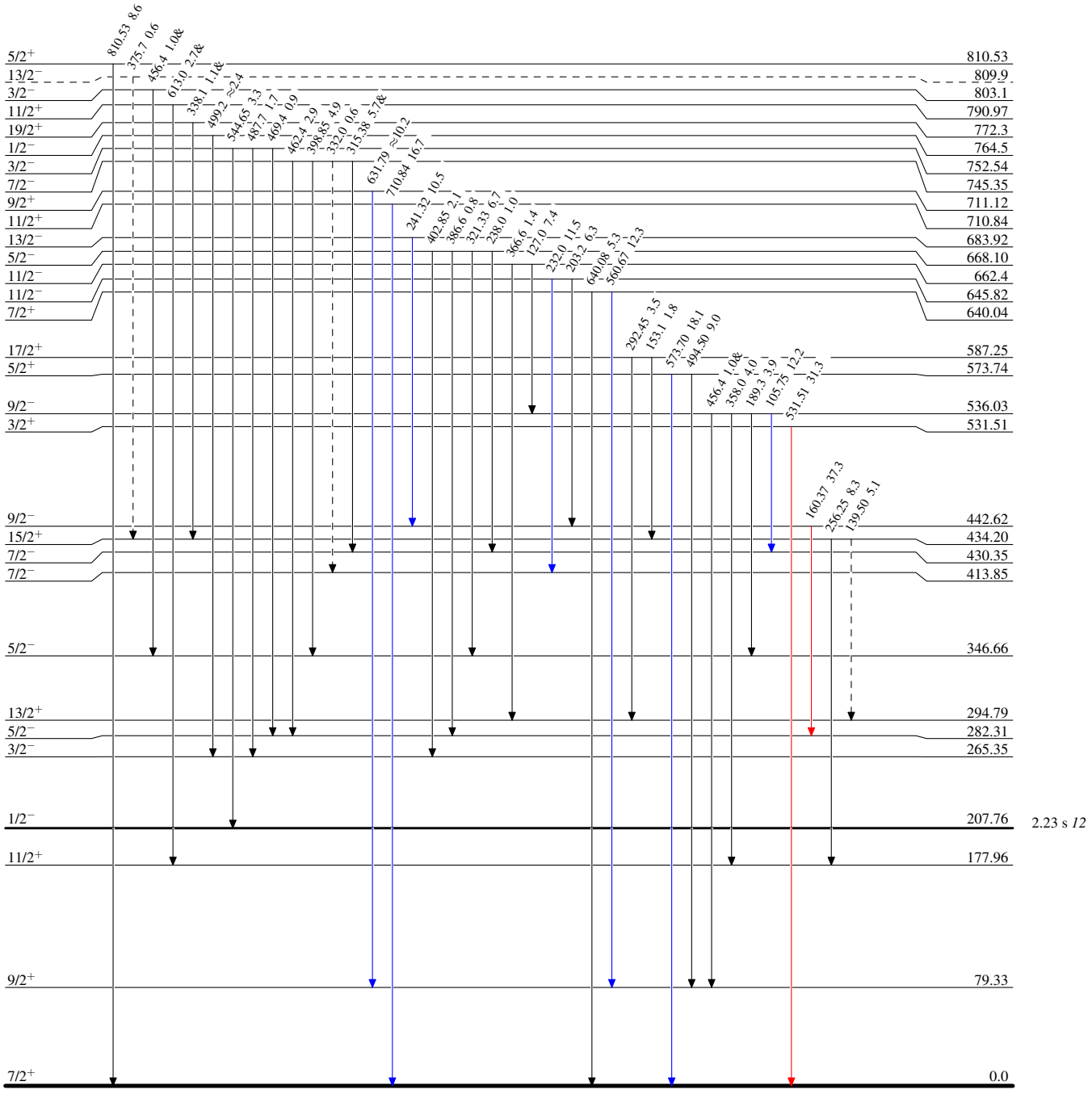
$^{167}_{68}Er_{99}$

^{167}Er(n,n′γ) 1979Bo44

Level Scheme (continued)

Intensities: Relative I_γ
& Multiply placed: undivided intensity given

Legend
$I_\gamma < 2\% \times I_\gamma^{max}$
$I_\gamma < 10\% \times I_\gamma^{max}$
$I_\gamma > 10\% \times I_\gamma^{max}$
γ Decay (Uncertain)

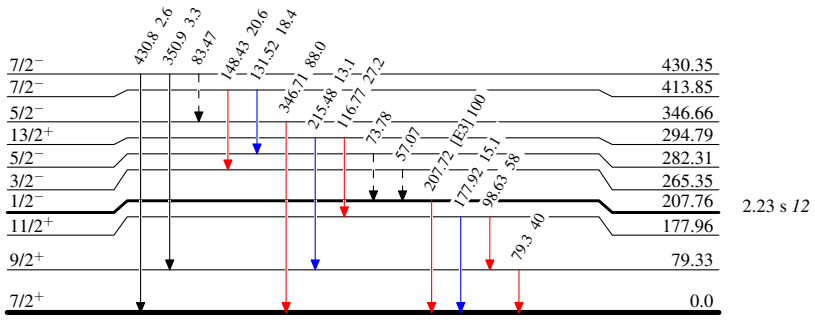


^{167}Er(n,n′γ) 1979Bo44

Level Scheme (continued)

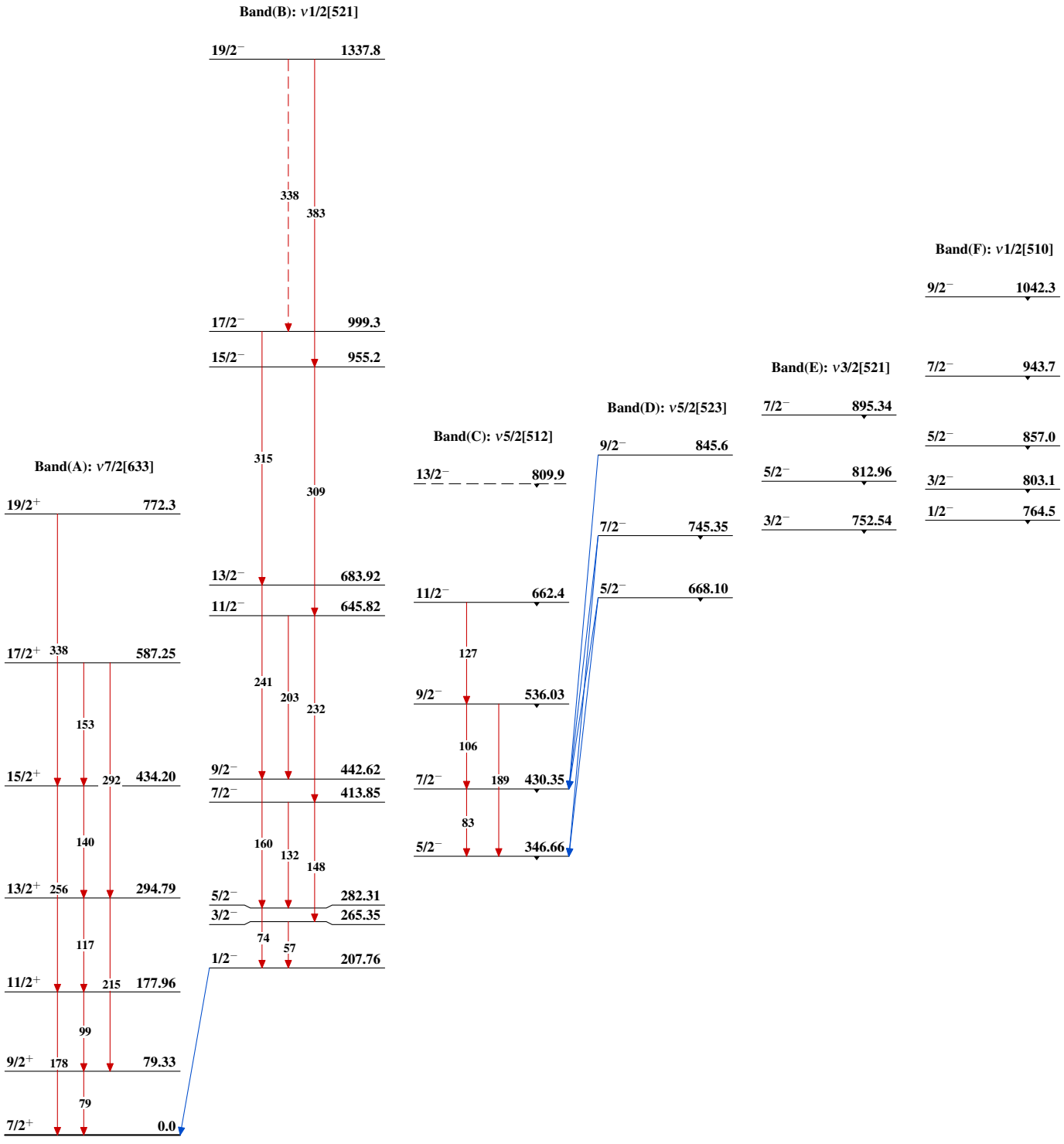
Intensities: Relative I_γ
& Multiply placed: undivided intensity given

Legend
$I_\gamma < 2\% \times I_\gamma^{max}$
$I_\gamma < 10\% \times I_\gamma^{max}$
$I_\gamma > 10\% \times I_\gamma^{max}$
γ Decay (Uncertain)



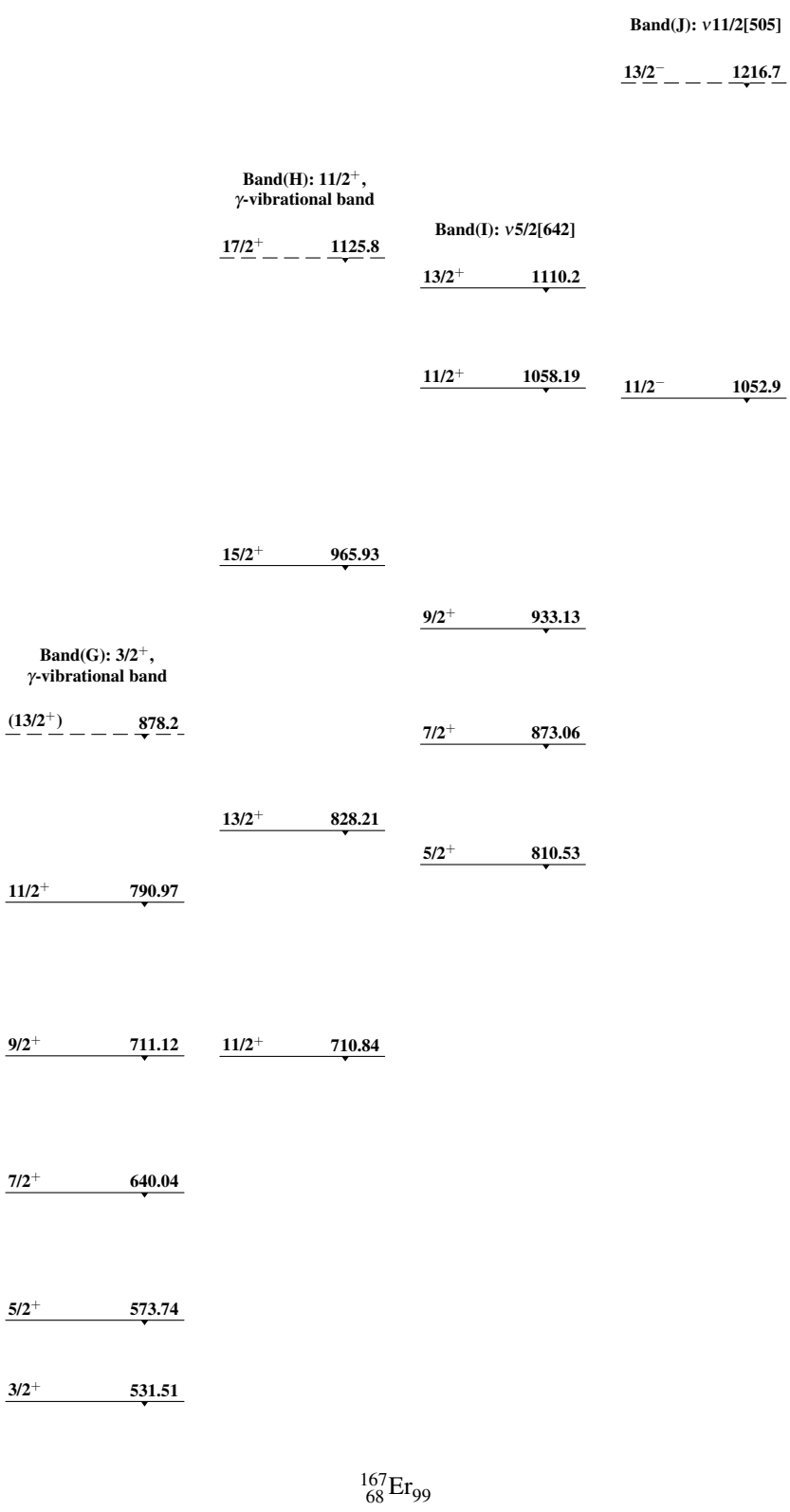
$^{167}_{68}Er_{99}$

^{167}Er(n,n′γ) 1979Bo44



$^{167}_{68}Er_{99}$

^{167}Er(n,n′γ) 1979Bo44 (continued)



$^{167}_{68}Er_{99}$