Coulomb excitation

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	N. Nica	NDS 170, 1 (2020)	16-Aug-2020

The scheme is primarily from 1972Th09 below 700 keV and all from 1998Sm06 above that energy.

Experiments:

1998Sm06: (^{58}Ni,^{58}Ni′) E=220 MeV. Measured Eγ, Iγ, and $T_{1/2}$ recoil-distance method using three Compton-suppressed Ge detectors. Deduced intrinsic g factors, B(E1), B(M1), and B(E2) values. Data were compiled earlier for XUNDL database by J. Chenkin and B. Singh (McMaster University).

1993BrZW: ^{58}Ni at 242 MeV; $T_{1/2}$ measured, published as 1998Sm06.

1972Th09: α at 8-12 MeV; and ^{35}Cl at 30-90 MeV, measured Eγ γγ coincidences; report 12 excited levels.

1971Le04: p at 4.5 MeV and α at 5-11 MeV; report 6 levels.

1970Za04: α at 12 MeV; report 6 levels.

1967Se09: ^{16}O at 50 MeV; report ground-state band to 15/2$^+$.

1966Bo16: ^{16}O at 45 MeV; report 4 levels.

1966As03: ^{16}O at ≈ 35 MeV; measured $T_{1/2}$ for 193 level.

1965As03: α at 3.1 MeV; report multipolarity data.

1964DeZY: ^{16}O at 18-42 MeV.

1962Go23: p at 4.5 MeV.

1960Ol02: p at 4.5 MeV; report one Iγ ratio.

1960Be16: p at 2.8 MeV and α at 3.0 MeV; report 4 K/L ratios.

1959De29: p at 4 MeV; measured γ(θ).

1957Cl44: p at 4 MeV.

1957Be56: α at 4 MeV.

1956Hu49: p at 1.75 MeV.

1956He78: α at 6 MeV.

1956Go47: p at 2.9 MeV.

1955Ma77: p at 2.9 MeV.

^{153}Eu Levels

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$[#]	Comments
0.0[@]	5/2$^+$		
83.36720[&] *21*	7/2$^+$	0.80 ns *2*	B(E2)↑=1.97 *10* B(E2)↑: Calculated from ^{35}Cl bombardment data of 1972Th09, using α=3.82 *12* based upon δ=0.80 *+14−10* deduced from the K/L ratio of 1960Be16. Others: 2.87 (1956He78), 2.6 (1956Hu49), 2.1 (1957Cl44), 2.5 (1959De29), and 2.28 *10* (1960Ol02). $T_{1/2}$: Weighted average of 0.80 ns *2* (1966As03) and 0.73 ns *7* (1972Th09); other: 0.78 ns *4* from B(E2).
97.43102[a] *21*	5/2$^-$	0.17 ns	B(E1)↑=0.000021 (1972Th09) $T_{1/2}$: From B(E1).
103.18016 *17*	3/2$^+$	3.1 ns	B(E2)↑=0.0049 (1972Th09) $T_{1/2}$: From B(E2).
151.4[b]	7/2$^-$	0.36 ns *7*	$T_{1/2}$: From (1972Th09).
172.9	5/2$^+$		
193.06[@] *5*	9/2$^+$	179 ps *9*	B(E2)↑=0.75 $T_{1/2}$: Weighted average of 173 ps *6* (1998Sm06), 201 ps *14* (1972Th09) and 208 ps *21* (1966As03); the reduced-χ^2 is 2.7. B(E2)↑: Average of 0.82 (1956He78), 0.64 (1957Cl44), 0.86 (1959De29), 0.70 (1960Ol02), and 0.75 (1970Za04).
235.0[a]	9/2$^-$		
269.9	(7/2$^+$)		

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Coulomb excitation (continued)

^{153}Eu Levels (continued)

E(level)[†]	J^{π}[‡]	$T_{1/2}$[#]	Comments
321.3[b]	11/2⁻		
324.97[&] *7*	11/2⁺	52 ps *3*	
477.5[a]	13/2⁻		
480.65[@] *11*	13/2⁺	19.8 ps *5*	
569.41 *14*	(7/2⁺)		B(E2)↑=0.034 *4* (1967Se09); other: 1971Le04 report B(E2)↑=0.027 *2* in (α,α′γ) and 0.027 *1* in (p,p′γ) and 1972Th09 report 0.033 *4* and 0.032 *3* (1972Th09).
587.4[b]	15/2⁻		
617.18 *24*	(5/2⁺)		B(E2)↑=0.0143 *20* (1967Se09) and 0.015 *3* and 0.008 *3* (1972Th09).
654.5[&] *3*	(15/2⁺)	10.05 ps *21*	
711.1 *7*	(9/2⁺)		
824.6[a]	17/2⁻	5.0 ps *4*	
850.7[@]	17/2⁺	5.96 ps *21*	$T_{1/2}$: Weighted average of 6.17 ps *4* for transition to 15/2⁻ and 5.8 ps *3* for transition to 13/2⁺.
953.6[b]	19/2⁻	4.6 ps *4*	
1061.0[&]	19/2⁺	5.5 ps *6*	$T_{1/2}$: Weighted average of 3.0 ps *4* for transition to 17/2⁺ and 5.55 ps *9* for transition to 15/2⁺; the reduced-χ^2 is 39.
1261.9[a]	21/2⁻	1.9 ps *4*	
1293.3[@]	21/2⁺	2.34 ps *8*	
1404.4[b]	23/2⁻		
1534.6[&]	23/2⁺	1.72 ps *7*	
1772.0[a]	25/2⁻		
1798.1[@]	25/2⁺	1.25 ps *10*	
1925.7[b]	27/2⁻		
2066.0[&]	27/2⁺		
2338.1[a]	29/2⁻		
2355.4[@]	29/2⁺		
2501.4[b]	31/2⁻		
2646.8[&]	31/2⁺		
2931.0[a]	33/2⁻		
2957.5[@]	33/2⁺		
3101.9[b]	35/2⁻		
3270.1[&]	35/2⁺		
3446.5[a]	37/2⁻		
3594.3[@]	37/2⁺		

[†] From least-squares fit to γ energies.
[‡] From ^{153}Eu Adopted Levels, except that many assignments in Adopted Levels are in parentheses.
[#] From 1998Sm06 by recoil-distance method, unless otherwise noted.
[@] Band(A): K^{π}=5/2⁺ band, α=+1/2.
[&] Band(a): K^{π}=5/2⁺ band, α=−1/2.
[a] Band(B): K^{π}=5/2⁻ band, α=+1/2.
[b] Band(b): K^{π}=5/2⁻ band, α=−1/2.

Coulomb excitation (continued)

$\gamma(^{153}Eu)$

E_i(level)	J^π_i	E_γ[†]	I_γ[‡]	E_f	J^π_f	Mult.[#]	δ[#]	α[e]	Comments
83.36720	7/2+	83.36717[b] *21*	100	0.0	5/2+	M1+E2	0.81 *4*	3.82 *12*	
97.43102	5/2−	97.43100[b] *21*	100	0.0	5/2+	E1			
103.18016	3/2+	103.18012[b] *17*	100	0.0	5/2+				
151.4	7/2−	54.2[c]		97.43102	5/2−				
		151.62[b]		0.0	5/2+				
172.9	5/2+	69.7	100	103.18016	3/2+				
		75.4	15	97.43102	5/2−				
193.06	9/2+	109.70 *5*	39.7 *25*	83.36720	7/2+	M1+E2	0.63 *8*		I_γ: Weighted average of 35.2 *22* (1962Go23), 42 *6* (1964DeZY), 45.4 *35* (1966Bo16), and 38.5 *31* (1967Se09).
		193.07 *9*	100	0.0	5/2+	E2			
235.0	9/2−	83.5[c]		151.4	7/2−				
		137.7[c]		97.43102	5/2−				
		151.9[c]		83.36720	7/2+				
269.9	(7/2+)	97.0	100	172.9	5/2+				
		166.7	8.3	103.18016	3/2+				
		172.5	6.0	97.43102	5/2−				
321.3	11/2−	86.8[c]		235.0	9/2−				
		128.8[c]		193.06	9/2+				
		170.3[c]		151.4	7/2−				
324.97	11/2+	89.4[c]		235.0	9/2−				
		131.93 *7*	14.7 *11*	193.06	9/2+				I_γ: Weighted average of 14.1 *16* (1966Bo16) and 15.1 *14* (1967Se09).
		241.63 *10*	100	83.36720	7/2+				
477.5	13/2−	153.3[c]		324.97	11/2+				
		156.2[c]		321.3	11/2−				
		242.6[c]		235.0	9/2−				
480.65	13/2+	156.0 *3*	8.8 *18*	324.97	11/2+				I_γ: From (1967Se09).
		159.3[c]		321.3	11/2−				
		287.58 *10*	100	193.06	9/2+				
569.41	(7/2+)	485.8 *2*	26[d] *8*	83.36720	7/2+				
		569.4 *2*	100	0.0	5/2+				
587.4	15/2−	108.4[c]		480.65	13/2+				
		111.6[c]		477.5	13/2−				
		267.8[c]		321.3	11/2−				
617.18	(5/2+)	533.6 *4*	70[d] *13*	83.36720	7/2+				
		617.3 *3*	100	0.0	5/2+				
654.5	(15/2+)	174.0[c]		480.65	13/2+				
		177.2[c]		477.5	13/2−				
		329.6 *3*		324.97	11/2+				
711.1	(9/2+)	518.3[&] *10*	100	193.06	9/2+				

From ENSDF

$^{153}_{63}Eu_{90}$-3

Coulomb excitation (continued)

γ(^{153}Eu) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π
711.1	(9/2$^+$)	628.1[&] *7*	92[d] *23*	83.36720	7/2$^+$
		710.2[a] *10*		0.0	5/2$^+$
824.6	17/2$^-$	170.3		654.5	(15/2$^+$)
		236.2		587.4	15/2$^-$
		347.9		477.5	13/2$^-$
850.7	17/2$^+$	197.0	7.8 *6*	654.5	(15/2$^+$)
		262.4		587.4	15/2$^-$
		370.8	100	480.65	13/2$^+$
953.6	19/2$^-$	103.7		850.7	17/2$^+$
		129.0		824.6	17/2$^-$
		365.3		587.4	15/2$^-$
1061.0	19/2$^+$	210.2	3.4 *10*	850.7	17/2$^+$
		236.3	13.5 *17*	824.6	17/2$^-$
		406.9	100	654.5	(15/2$^+$)
1261.9	21/2$^-$	201.0		1061.0	19/2$^+$
		308.2		953.6	19/2$^-$
		437.3		824.6	17/2$^-$
1293.3	21/2$^+$	232.5	3.8 *8*	1061.0	19/2$^+$
		339.6	11 *2*	953.6	19/2$^-$
		442.6	100	850.7	17/2$^+$
1404.4	23/2$^-$	111.0		1293.3	21/2$^+$
		142.9		1261.9	21/2$^-$
		450.6		953.6	19/2$^-$
1534.6	23/2$^+$	241.2		1293.3	21/2$^+$
		272.6	9 *3*	1261.9	21/2$^-$
		473.7	100	1061.0	19/2$^+$
1772.0	25/2$^-$	237.3		1534.6	23/2$^+$
		367.6		1404.4	23/2$^-$
		510.1		1261.9	21/2$^-$
1798.1	25/2$^+$	263.2		1534.6	23/2$^+$

E_i(level)	J_i^π	E_γ[†]	E_f	J_f^π
1798.1	25/2$^+$	393.9	1404.4	23/2$^-$
		504.9	1293.3	21/2$^+$
1925.7	27/2$^-$	127.4	1798.1	25/2$^+$
		153.7	1772.0	25/2$^-$
		521.3	1404.4	23/2$^-$
2066.0	27/2$^+$	267.7	1798.1	25/2$^+$
		294.1	1772.0	25/2$^-$
		531.4	1534.6	23/2$^+$
2338.1	29/2$^-$	272.0	2066.0	27/2$^+$
		412.4	1925.7	27/2$^-$
		566.1	1772.0	25/2$^-$
2355.4	29/2$^+$	429.9	1925.7	27/2$^-$
		557.5	1798.1	25/2$^+$
2501.4	31/2$^-$	146.5	2355.4	29/2$^+$
		163.4	2338.1	29/2$^-$
		575.5	1925.7	27/2$^-$
2646.8	31/2$^+$	308.7	2338.1	29/2$^-$
		580.7	2066.0	27/2$^+$
2931.0	33/2$^-$	284.1	2646.8	31/2$^+$
		429.8	2501.4	31/2$^-$
		592.8	2338.1	29/2$^-$
2957.5	33/2$^+$	456.4	2501.4	31/2$^-$
		601.8	2355.4	29/2$^+$
3101.9	35/2$^-$	170.9	2931.0	33/2$^-$
		600.6	2501.4	31/2$^-$
3270.1	35/2$^+$	623.3	2646.8	31/2$^+$
3446.5	37/2$^-$	344.7	3101.9	35/2$^-$
		515.5	2931.0	33/2$^-$
3594.3	37/2$^+$	636.8	2957.5	33/2$^+$

[†] Values for γ's from levels below 800 keV are from 1972Th09, except as otherwise indicated and values for γ's from levels above this energy are from 1998Sm06.

[‡] Values for γ's from levels below 800 keV are from references indicated and values for γ's from levels above this energy are from 1998Sm06.

[#] From ^{153}Eu Adopted γ's.

[@] From 1967Se09.

[&] From 1971Le04.

[a] From 1971Le04, assignment to ^{153}Eu uncertain.

[b] From ^{153}Eu Adopted γ radiations.

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Coulomb excitation (continued)

$\gamma(^{153}Eu)$ (continued)

[c] From 1998Sm06.
[d] From 1971Le04.
[e] 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.
[x] γ ray not placed in level scheme.

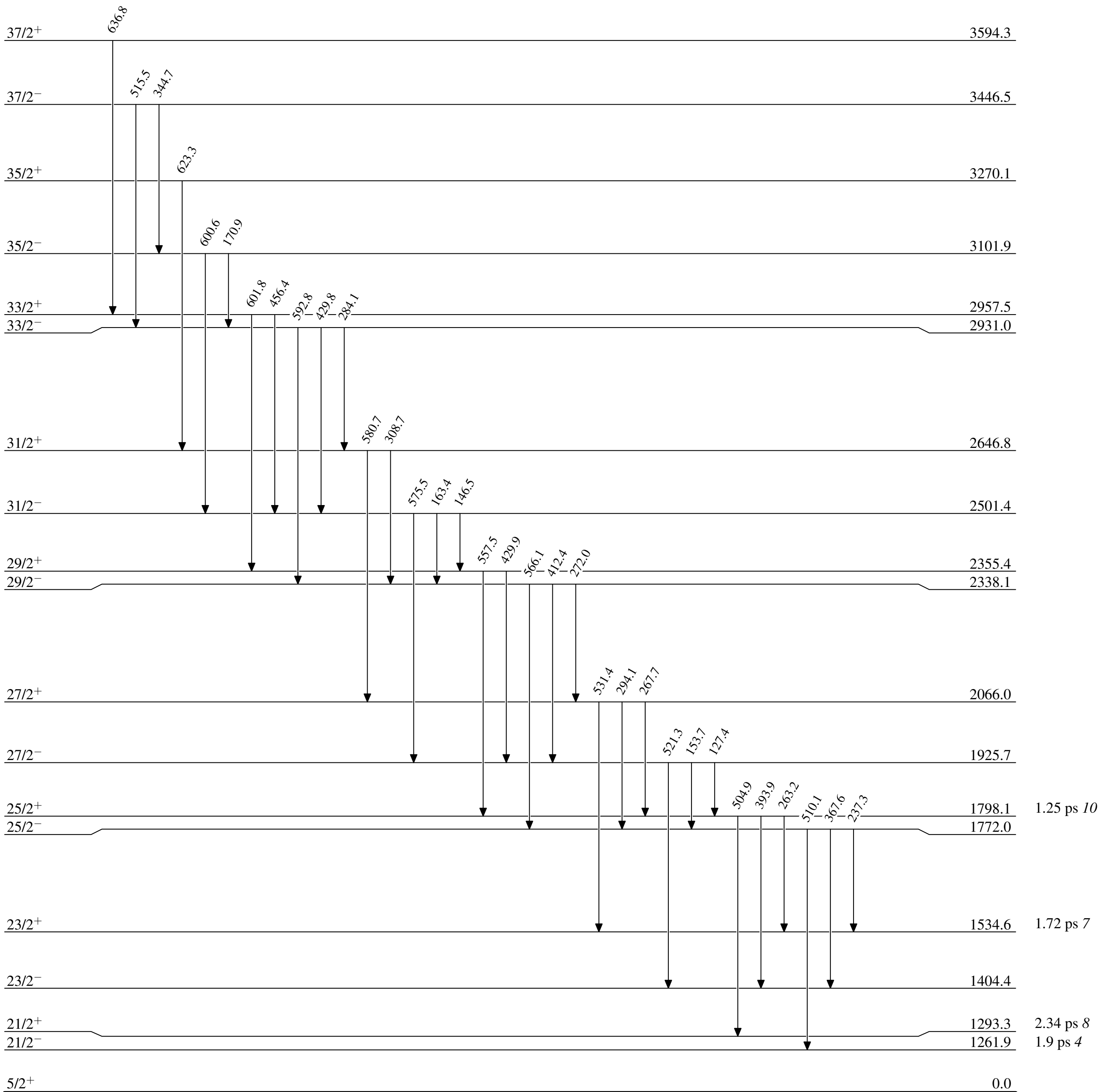
From ENSDF

$^{153}_{63}Eu_{90}$-5

Coulomb excitation

Level Scheme

Intensities: Relative photon branching from each level

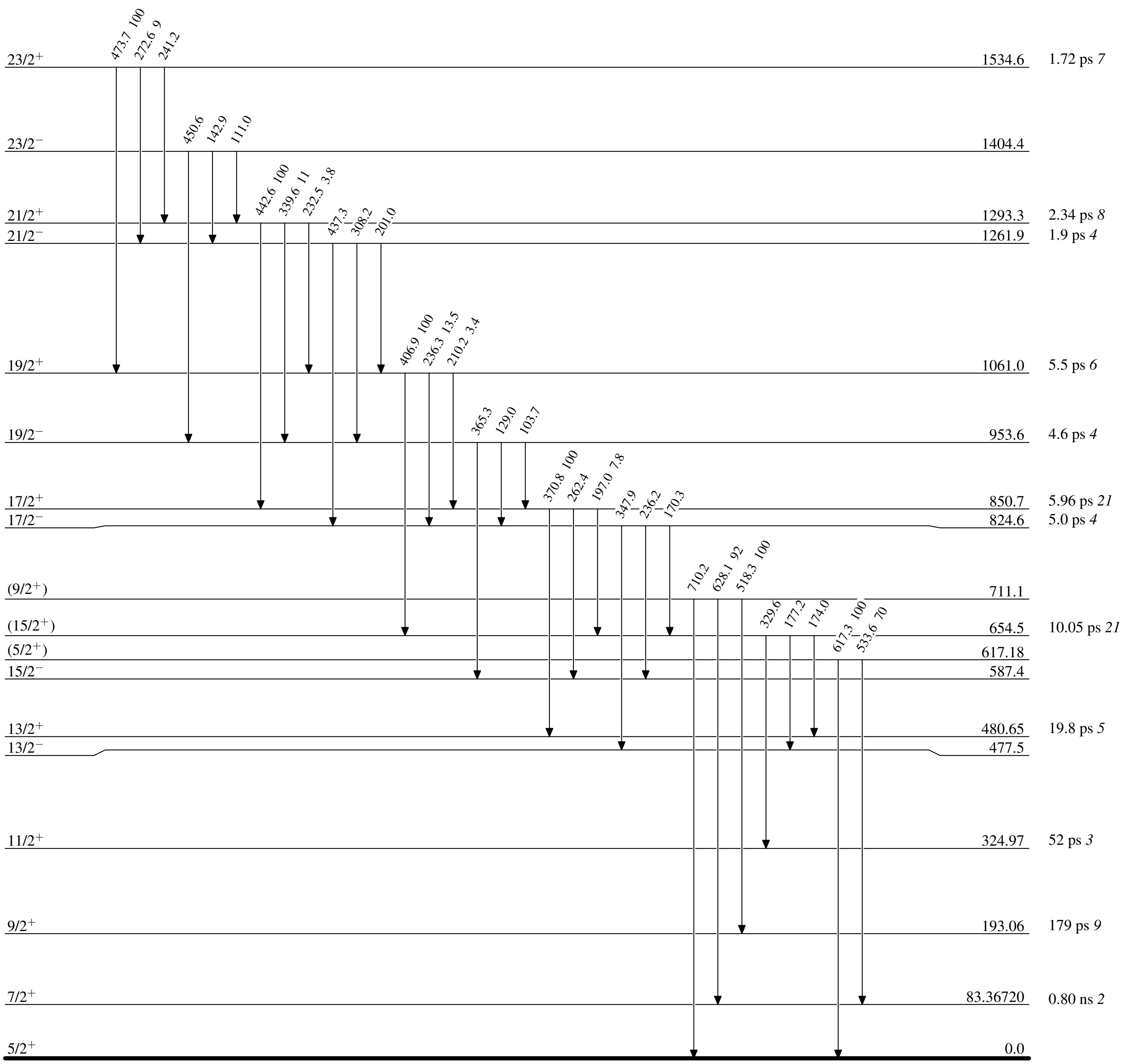


$^{153}_{63}Eu_{90}$

Coulomb excitation

Level Scheme (continued)

Intensities: Relative photon branching from each level

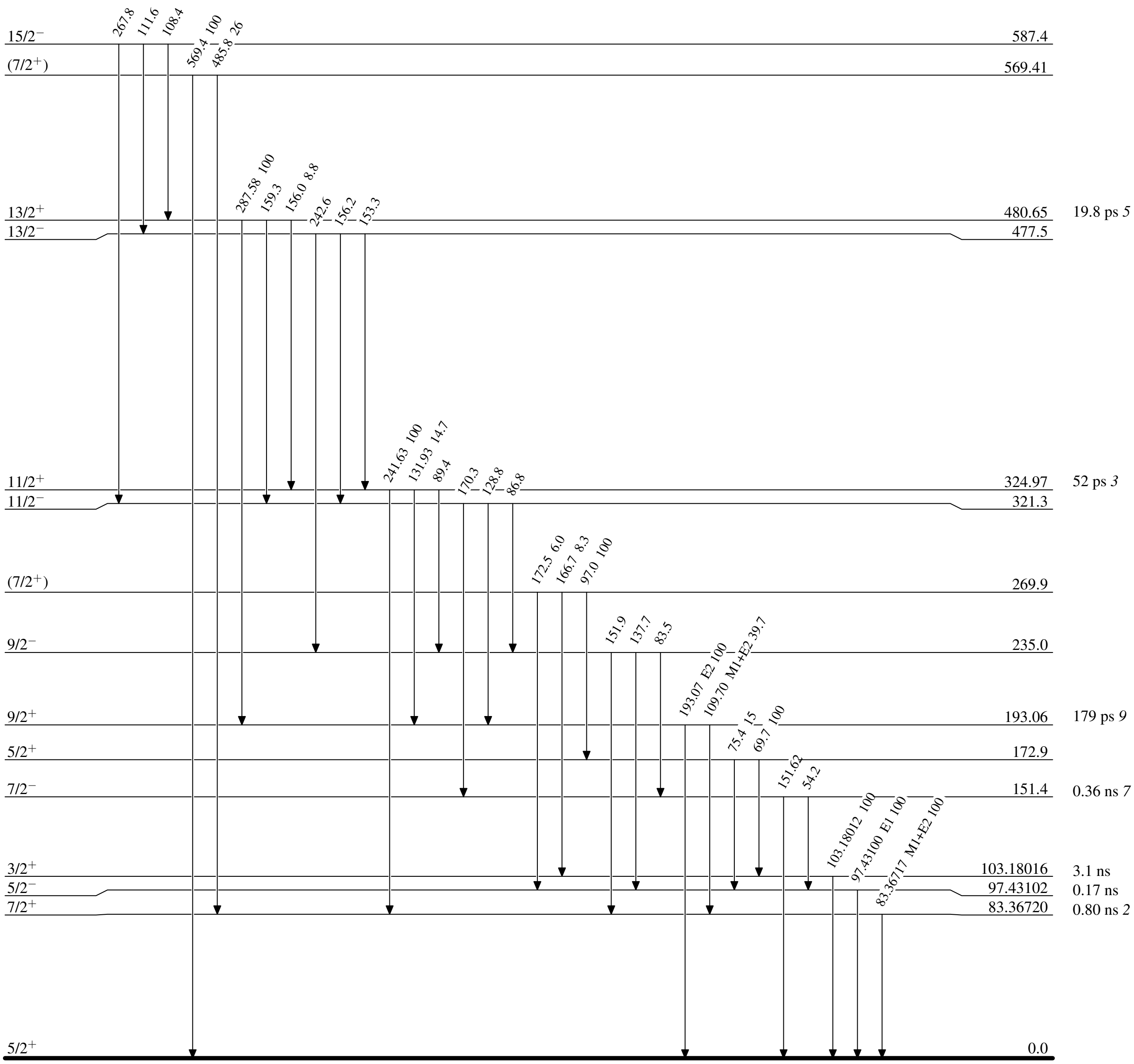


$^{153}_{63}Eu_{90}$

Coulomb excitation

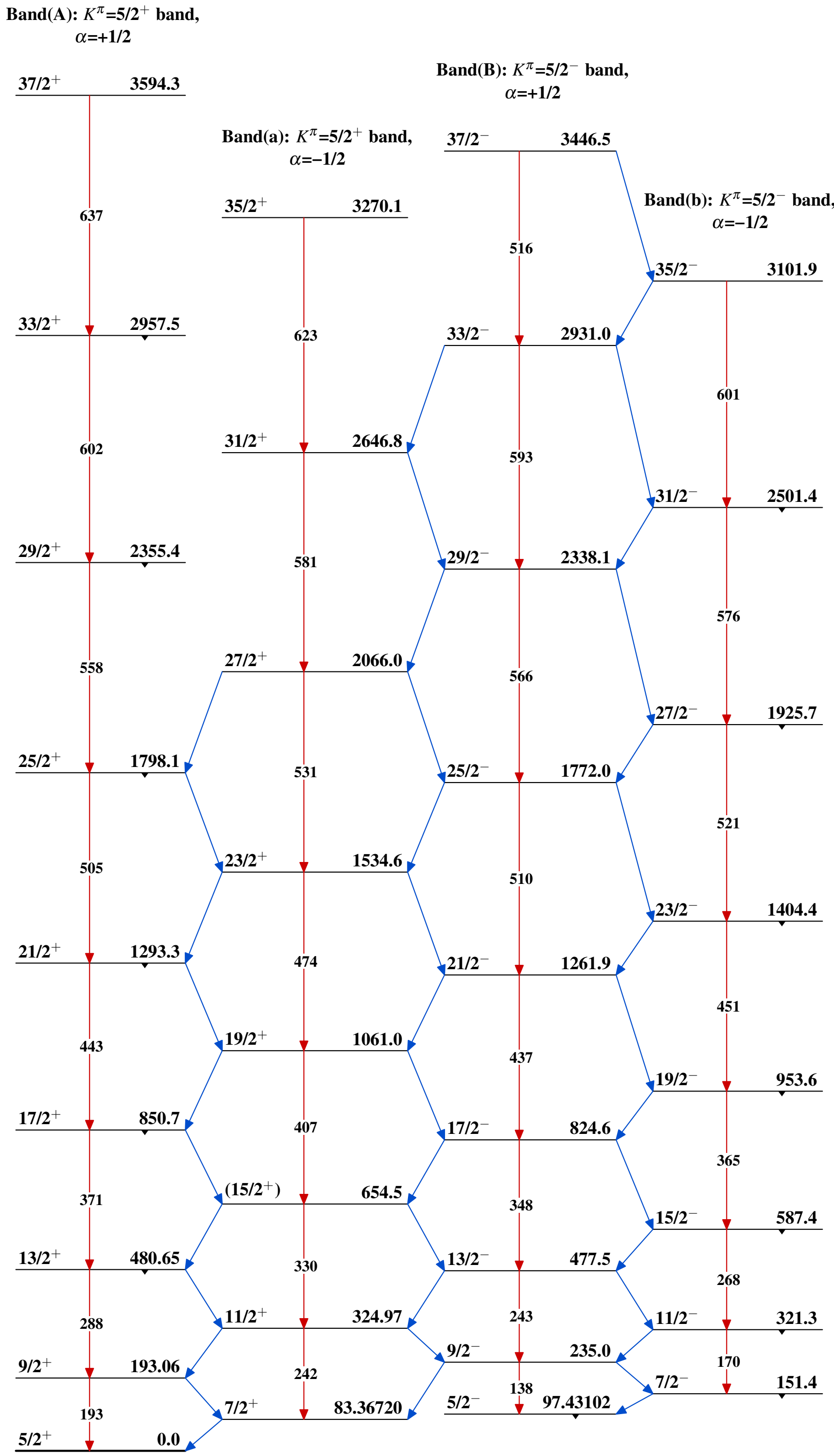
Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{153}_{63}Eu_{90}$

Coulomb excitation



$^{153}_{63}$Eu$_{90}$