Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	E. Browne, J. K. Tuli	NDS 122, 293 (2014)	30-Jun-2013

Q(β^-)=722.5 *10*; S(n)=6215.2 *11*; S(p)=5285.5 *15*; Q(α)=4599 *14* 2012Wa38

Additional information 1.

Calculations.

Single-particle levels: 2004Pa40.

Half-life: 2013Zd01, 2008Do12.

β^- decay: 2009So02.

Evaluation of ^{239}U β^- decay: 2008BeZV.

Nuclear reactions.

^{238}Np(n,γ) E=thermal. Calculated σ: 2012Pr13, 2011Ch57, 2004Ha11, 2010Pr07.

^{232}Th, U(n,F), U(n,γ), U(n,2n): Deduced reaction rates: 2011Ad18.

Cluster decay.

^{239}Np(^{30}Mg): 2012Sa31.

Alpha decay.

^{239}Np (α): Calculated $T_{1/2}$, Q(α): 2011Sa40.

^{243}Am(α): Theory: 2003De17.

^{239}Np Levels

Cross Reference (XREF) Flags

A ^{239}U β^- decay
B ^{243}Am α decay
C ^{238}U(^{3}He,d),(α,t)

E(level)[†]	J$^\pi$[#]	$T_{1/2}$	XREF	Comments
0[a]	5/2$^+$	2.356 d *3*	ABC	%β^-=100 %$\alpha\approx 1\times10^{-10}$ from α syst (1980Sc26). J$^\pi$: atomic beam (1969Fu11), E1 from 5/2$^-$. $T_{1/2}$: Weighted average (Limited Relative Statistical Weight Method) of 2.346 d *4* (1956Wi25), 2.366 d *3* (1959Co93), 2.340 d *20* (1959Co63), 2.354 d *8* (1966Qa01), 2.346 d *4* (1969Bi12), and 2.3565 d *4* (1990Ab06). (χ^2/ν=4.9, data are discrepant.).
31.1309[a] *12*	7/2$^+$		ABC	
71.13[a] *3*	9/2$^+$		ABC	
74.6640[b] *10*	5/2$^-$	1.39 ns *3*	ABC	μ=+2.0 *3* J$^\pi$: Favored α decay (HF=1.14) from 5/2-5/2[523] in ^{243}Am. $T_{1/2}$: From ^{243}Am α decay. μ: From 2011StZZ, 1967Gu08 Integral perturbed angular correlation. Compare to +1.95 *15* for 5/2[523] in ^{237}Np and +3.14 *4* for 5/2[642] in ^{237}Np. In ^{243}Am the 5/2[523] g.s. has μ=+1.503 *14* (2011StZZ,1990Iz01).
117.715[‡b] *10*	7/2$^-$	≤40 ps	ABC	$T_{1/2}$: from ^{243}Am α decay.
122.5[a] *10*	(11/2$^+$)		ABC	
173.086[‡b] *18*	9/2$^-$		ABC	
180.0[a] *12*	(13/2$^+$)		C	
220.2[c] *12*	(1/2$^+$)[@]		C	J$^\pi$: Tentative assignment is based on the analogy with the same rotational band in ^{237}Np.
241.312[b] *24*	(11/2$^-$)		ABC	

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Adopted Levels, Gammas (continued)

^{239}Np Levels (continued)

E(level)[†]	Jπ[#]	XREF	Comments
257.63?[c] 25	(3/2+)[@]	A C	
260.81[d] 3	(3/2−)[&]	A C	Jπ: assignment is based on the analogy with the same rotational band in ^{237}Np.
267?[‡] 3		B	
270.9[d] 14	(1/2−)[&]	C	
315.5[d] 11	(7/2−)[&]	C	
317.4[‡b] 15	(13/2−)	B	
325[‡d] 3	(5/2−)[&]	BC	
347.33 23	(9/2+,7/2+)	ABC	Jπ: 9/2+ from (^{3}He,d). However, from α HF and analogy to ^{237}Np, this could be 7/2+ member of 1/2[400].
359.12[c] 20	(9/2+)[@]	AB	
411[‡] 3		B	
420.6 22		C	
427[‡] 3		B	
438.79[c] 5	(11/2+)[@]	ABC	
448.15[e] 3	(3/2−)	A C	Jπ: Fingerprint of (^{3}He,d) cross-section.
452.76 4	(5/2+,7/2−)	A	Jπ: γ's to 9/2+ and (3/2−).
474.36? 6		A	
482.6[e] 11	(5/2−)	C	
517.98[e] 3	(7/2−)	A C	
530.21? 8		A	
547.0? 23	(13/2+)	C	
563.87 5		A	
579.34[e] 7	(9/2−)	A C	
600? 3		C	
616? 3		C	
637.2? 18		C	
657?[e] 3	(11/2−)	C	
662.261[h] 15	(5/2−)	AB	Jπ: Low α hindrance factor (HF=7.13) from ^{243}Am α decay. γ rays to 5/2 and 7/2 levels.
695.10[h] 4	(7/2−)	A C	
723.7 22		C	
741.6[h] 21	(9/2−)	C	
778.6 13		C	
784.96? 5		A	
819.209 18	(7/2−)	A	Jπ: γ to (3/2−) and (11/2−).
823.4 17		C	
844.072 15	(7/2−)	A	Jπ: γ rays to 5/2+, 9/2+, (11/2−); Possible bandhead of 7/2[633].
849.45 4		A	
863.43? 9		A	
864.9[f] 12	(9/2+)	C	Jπ: from (^{3}He,d).
890.6 12		C	
917.1 11		C	
951.5 13		C	
959.17 3		A	
964.08 17	(7/2−)	A	Jπ: γ to (5/2−), (11/2−).
966.53 6		A	
992.05[g] 3	(7/2−)	A C	Jπ: Tentatively assigned (7/2−) in (^{3}He,d).
1019.9[f] 12	(13/2+)	C	
1040.39 4	(5/2−,7/2−)	A	Jπ: 780γ to (3/2−), 867γ to 9/2−.
1049.45[g] 5	(9/2−)	A C	
1077.2 14		C	
1096.98 5	(7/2+)	A	Jπ: γ to (11/2+), (5/2−), (5/2+).

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Adopted Levels, Gammas (continued)

^{239}Np Levels (continued)

E(level)[†]	Jπ[#]	XREF
1117.8[g] *13*	(11/2⁻)	C
1141.1 *17*		C
1155.3 *19*		C
1182.5 *14*		C
1197.14? *10*		A

† From ^{239}U β^- Decay, unless otherwise specified.
‡ From ^{243}Am α Decay.
# J^π and configuration assignments are based on rotational band structure and systematics of Nilsson orbitals in nearby odd-A nuclei. Individual arguments are given mostly for rotational bandheads.
@ From (^{3}He,d), based on measured L values and a comparison between experimental and calculated spectroscopic factors for various Nilsson orbitals.
& From (^{3}He,d), rotational band parameter analogy to ^{237}Np.
[a] Band(A): 5/2[642].
[b] Band(B): 5/2[523].
[c] Band(C): 1/2[400]?
[d] Band(D): 1/2[530].
[e] Band(E): 3/2[521].
[f] Band(F): 7/2[633]?
[g] Band(G): 7/2[514].
[h] Band(H): 5/2[523]×0^+.

Adopted Levels, Gammas (continued)

γ(^{239}Np)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.	δ	α[@]	Comments
31.1309	7/2$^+$	31.131 *2*	100	0	5/2$^+$	M1+E2	0.08 *2*	196 *20*	δ: from α decay; other: 0.17 *1* In β$^-$ decay.
71.13	9/2$^+$	(71.2)	100	0	5/2$^+$	[E2]		73.5	
74.6640	5/2$^-$	43.533 *1*	8.27 *15*	31.1309	7/2$^+$	E1		1.16	B(E1)(W.u.)=8.7×10^{-5} *5*
		74.664 *1*	100	0	5/2$^+$	E1		0.28	B(E1)(W.u.)=0.000208 *15*
117.715	7/2$^-$	43.1[#]	11.5[#]	74.6640	5/2$^-$	M1+E2	≈0.38	≈159	B(M1)(W.u.)>0.032; B(E2)(W.u.)>6.9×10^2
		86.71[#] *2*	59[#] *7*	31.1309	7/2$^+$	E1		0.19	B(E1)(W.u.)>0.00013
		117.60[#] *15*	100[#] *14*	0	5/2$^+$	E1		0.086	B(E1)(W.u.)>0.00013
173.086	9/2$^-$	50.6[‡]	≈2.6[‡]	122.5	(11/2$^+$)	[E1]		0.78	
		55.4[‡]	≈8.7[‡]	117.715	7/2$^-$	M1+E2	0.6 *2*	87 *25*	
		98.5[‡]	≈8.2[‡]	74.6640	5/2$^-$	(E2)		15.9	
		141.89[‡] *3*	100[‡] *7*	31.1309	7/2$^+$	E1		0.226	
241.312	(11/2$^-$)	169	100	71.13	9/2$^+$	[E1]		0.15	
260.81	(3/2$^-$)	142.93	7.1	117.715	7/2$^-$				
		186.15 *4*	100 *10*	74.6640	5/2$^-$				
		260.86 *9*	11 *1*	0	5/2$^+$				
317.4	(13/2$^-$)	195[‡]	100[‡]	122.5	(11/2$^+$)	[E1]			
438.79	(11/2$^+$)	197.28 *12*	75 *13*	241.312	(11/2$^-$)				
		407.70 *5*	100	31.1309	7/2$^+$				
448.15	(3/2$^-$)	187.28 *8*	23 *3*	260.81	(3/2$^-$)				
		330.14 *14*	2.8 *6*	117.715	7/2$^-$				
		373.51 *4*	100 *7*	74.6640	5/2$^-$				
		448.19 *6*	37 *3*	0	5/2$^+$				
452.76	(5/2$^+$,7/2$^-$)	191.97 *6*	25	260.81	(3/2$^-$)				
		378.06 *6*	100 *9*	74.6640	5/2$^-$				
		381.27 *16*	6.4 *18*	71.13	9/2$^+$				
474.36?		399.13 *13*	89 *16*	74.6640	5/2$^-$				
		474.5 *1*	100 *13*	0	5/2$^+$				
517.98	(7/2$^-$)	486.87 *3*	100 *7*	31.1309	7/2$^+$				
		518.01 *9*	7.3 *7*	0	5/2$^+$				
530.21?		455.26 *18*	40 *16*	74.6640	5/2$^-$				
		499.1 *1*	100 *13*	31.1309	7/2$^+$				
		530.5 *2*	53	0	5/2$^+$				
563.87		111.0 *2*	100	452.76	(5/2$^+$,7/2$^-$)				
		492.76 *7*	26 *2*	71.13	9/2$^+$				
		532.86 *10*	12 *2*	31.1309	7/2$^+$				
		564.09 *20*	2 *1*	0	5/2$^+$				
579.34	(9/2$^-$)	504.76 *8*	100 *8*	74.6640	5/2$^-$				
		547.99 *16*	38 *8*	31.1309	7/2$^+$				
662.261	(5/2$^-$)	544.48 *9*	2.1 *2*	117.715	7/2$^-$				
		587.63 *5*	11.4 *5*	74.6640	5/2$^-$				
		631.10 *3*	40 *2*	31.1309	7/2$^+$				

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Adopted Levels, Gammas (continued)

γ(^{239}Np) (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f
662.261	(5/2−)	662.26 *2*	100 *6*	0	5/2+
695.10	(7/2−)	220.52 *4*	100 *10*	474.36?	
		522.12 *10*	8.5 *10*	173.086	9/2−
		577.15[&] *14*	≤4.8[&]	117.715	7/2−
		624.11 *7*	22 *1*	71.13	9/2+
		664.17 *9*	19 *2*	31.1309	7/2+
		695.18 *8*	13 *1*	0	5/2+
819.209	(7/2−)	240.00 *15*	0.67 *18*	579.34	(9/2−)
		255.71 *12*	0.9 *2*	563.87	
		558.46 *17*	0.46 *18*	260.81	(3/2−)
		577.15[&] *14*	≤1.1[&]	241.312	(11/2−)
		646.26 *10*	2.2 *2*	173.086	9/2−
		748.09 *3*	69 *4*	71.13	9/2+
		788.19 *7*	3.8 *3*	31.1309	7/2+
		819.19 *2*	100 *5*	0	5/2+
844.072	(7/2−)	326.21 *7*	3.2 *3*	517.98	(7/2−)
		602.79 *2*	3.5 *2*	241.312	(11/2−)
		769.52 *17*	0.3 *1*	74.6640	5/2−
		772.95 *5*	2.1 *2*	71.13	9/2+
		812.93 *4*	50 *3*	31.1309	7/2+
		844.10 *4*	100 *5*	0	5/2+
849.45		490.33 *13*	4.5 *9*	359.12	(9/2+)
		502.12 *17*	3.9 *12*	347.33	(9/2+,7/2+)
		588.70 *8*	36 *2*	260.81	(3/2−)
		591.82 *19*	6 *2*	257.63?	(3/2+)
		727.52 *10*	17 *2*	122.5	(11/2+)
		774.77 *4*	100 *6*	74.6640	5/2−
		849.44[&#] *9*	13[&#] *1*	0	5/2+
863.43?		201.09 *8*	12 *4*	662.261	(5/2−)
		746.06 *11*	100 *13*	117.715	7/2−
		862.56 *18*	10 *3*	0	5/2+
959.17		174.07 *6*	100 *10*	784.96?	
		296.93 *8*	≤15	662.261	(5/2−)
		395.19 *11*	21 *3*	563.87	
		841.48 *12*	26 *4*	117.715	7/2−
		884.45 *5*	89 *5*	74.6640	5/2−
		887.83 *10*	24 *3*	71.13	9/2+
		928.00[a] *6*	53 *3*	31.1309	7/2+
		959.48 *6*	80 *5*	0	5/2+
964.08	(7/2−)	301.64 *15*	1.2 *3*	662.261	(5/2−)
		703.63 *10*	2.6 *3*	260.81	(3/2−)
964.08	(7/2−)	722.85 *4*	30 *2*	241.312	(11/2−)
		791.33 *6*	8.3 *5*	173.086	9/2−
		846.39 *4*	35 *2*	117.715	7/2−
		889.49 *4*	23 *1*	74.6640	5/2−
		933.09 *3*	29 *2*	31.1309	7/2+
		964.30 *5*	100 *5*	0	5/2+
966.53		304.17 *10*	57	662.261	(5/2−)
		514.1 *3*	23	452.76	(5/2+,7/2−)
		793.55 *8*	100	173.086	9/2−
		849.44[&] *9*	72[&] *8*	117.715	7/2−
		895.15 *15*	30 *7*	71.13	9/2+
992.05	(7/2−)	296.93 *13*	≤14	695.10	(7/2−)
		874.22 *7*	32 *2*	117.715	7/2−
		917.40 *8*	25 *2*	74.6640	5/2−
		920.95 *8*	25 *2*	71.13	9/2+
		960.99 *5*	100 *5*	31.1309	7/2+
		992.00 *7*	27 *2*	0	5/2+
1040.39	(5/2−,7/2−)	258.80 *16*	3.8 *10*	784.96?	
		345.13 *8*	20 *2*	695.10	(7/2−)
		567.88 *18*	2 *1*	474.36?	
		587.63 *5*	100 *5*	452.76	(5/2+,7/2−)
		779.57 *14*	3 *1*	260.81	(3/2−)
		867.11 *10*	4.0 *5*	173.086	9/2−
		922.83 *13*	3.1 *6*	117.715	7/2−
		965.58 *10*	10	74.6640	5/2−
		1009.38 *18*	1.50 *5*	31.1309	7/2+
		1040.19 *9*	5.8 *5*	0	5/2+
1049.45	(9/2−)	876.14 *7*	35	173.086	9/2−
		931.97 *7*	100 *7*	117.715	7/2−
		974.91 *14*	7.5 *15*	74.6640	5/2−
		1018.14 *13*	≤19	31.1309	7/2+
1096.98	(7/2+)	312.05 *3*	100	784.96?	
		434.44 *13*	23 *4*	662.261	(5/2−)
		644.12 *14*	38 *8*	452.76	(5/2+,7/2−)
		658.5 *4*	11	438.79	(11/2+)
		1065.76 *12*	12 *2*	31.1309	7/2+
		1096.92 *8*	33 *3*	0	5/2+
1197.14?		535.01 *14*	100	662.261	(5/2−)
		1122.8 *3*	52	74.6640	5/2−
		1196.90 *15*	70	0	5/2+

From ENSDF

$^{239}_{93}Np_{146}$-5

Adopted Levels, Gammas (continued)

$\gamma(^{239}Np)$ (continued)

† From ^{239}U β^- Decay, unless otherwise specified.
‡ From ^{243}Am α Decay.
# Eγ from ^{243}Am α Decay. Iγ, weighted average from ^{239}U β^- Decay and ^{243}Am α 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.
& Multiply placed with undivided intensity.
a Placement of transition in the level scheme is uncertain.

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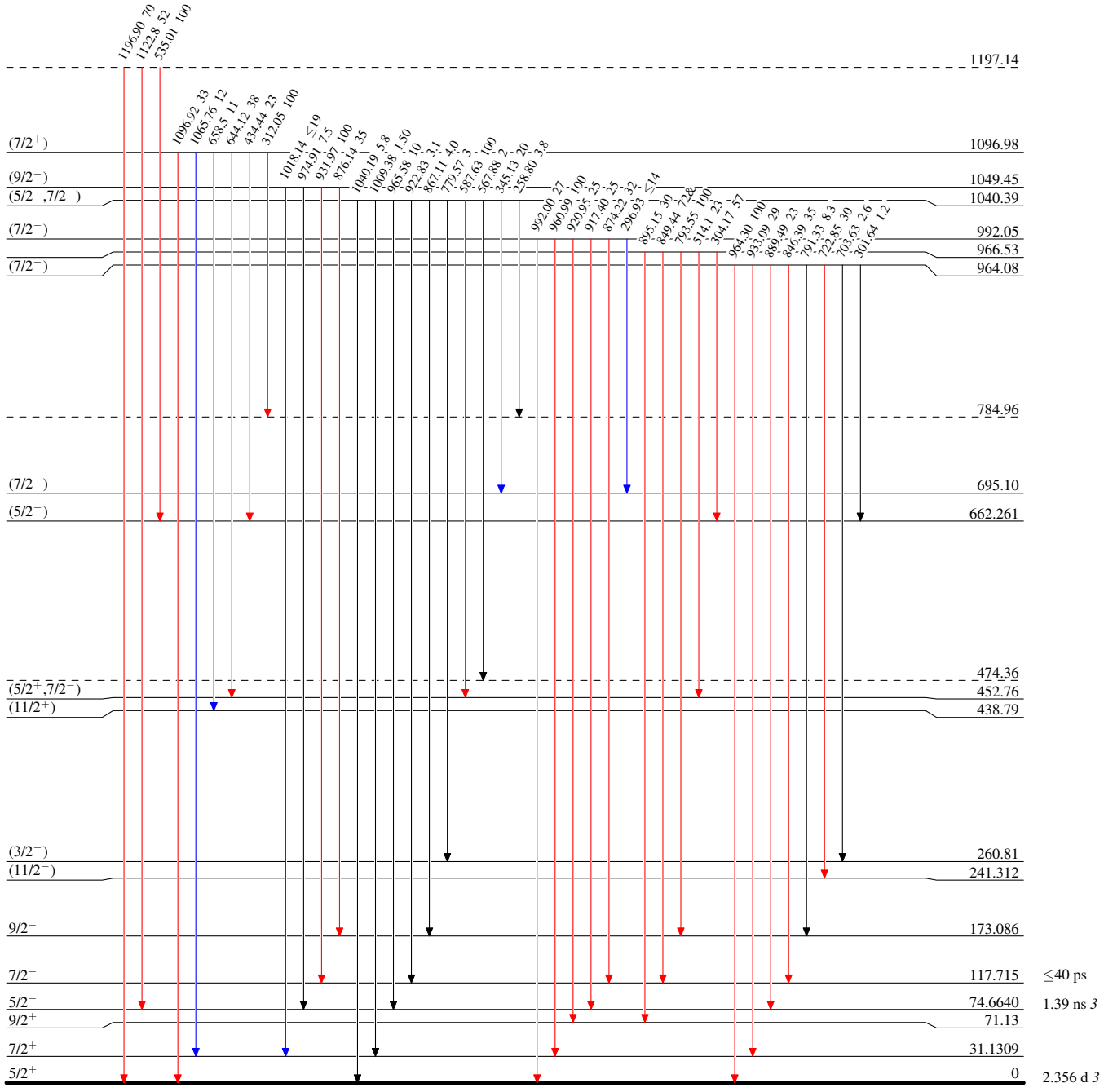
Adopted Levels, Gammas

Level Scheme

Intensities: Type not specified
& Multiply placed: undivided intensity given

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



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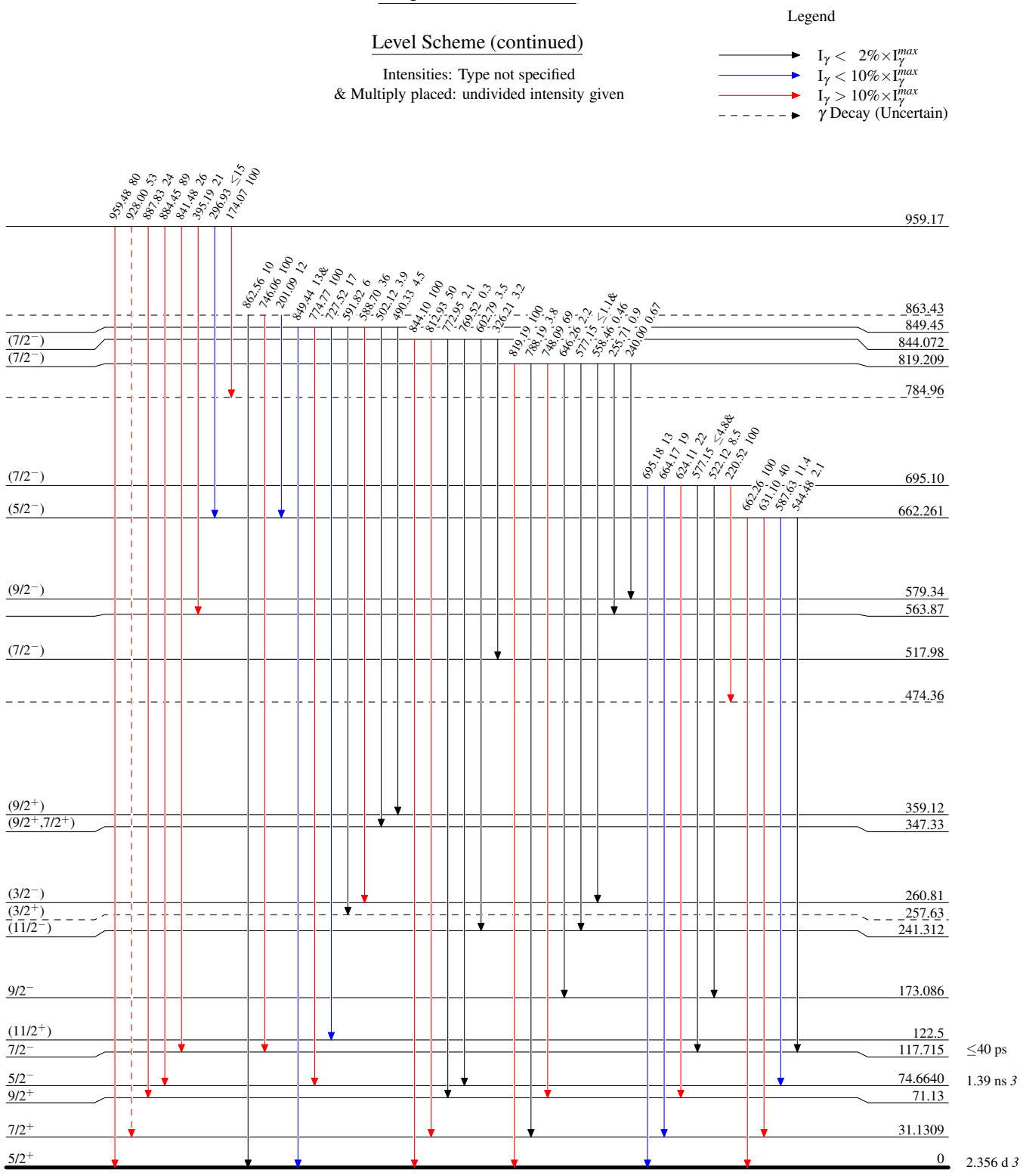
Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Type not specified
& Multiply placed: undivided intensity given



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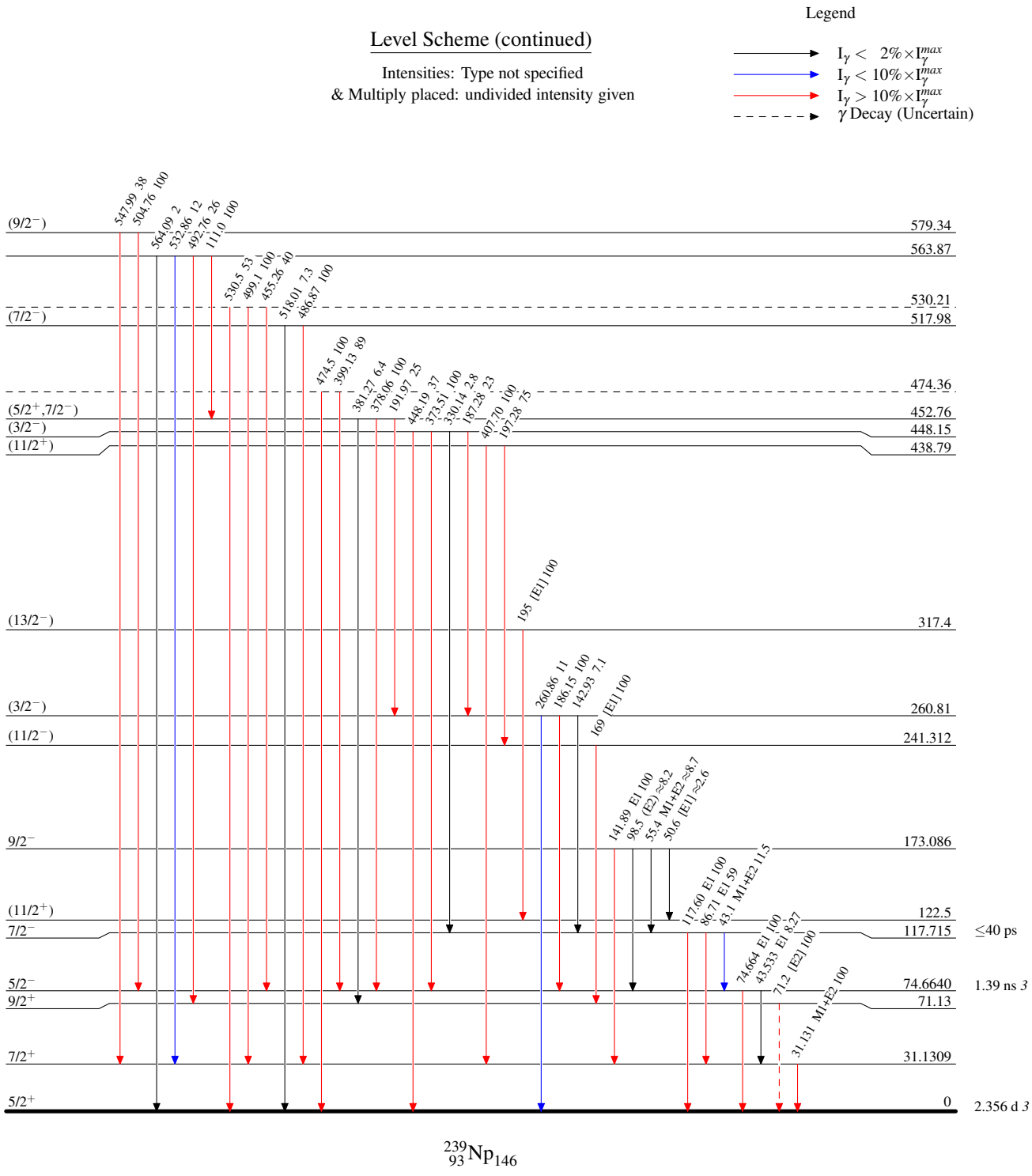
Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Type not specified
& Multiply placed: undivided intensity given



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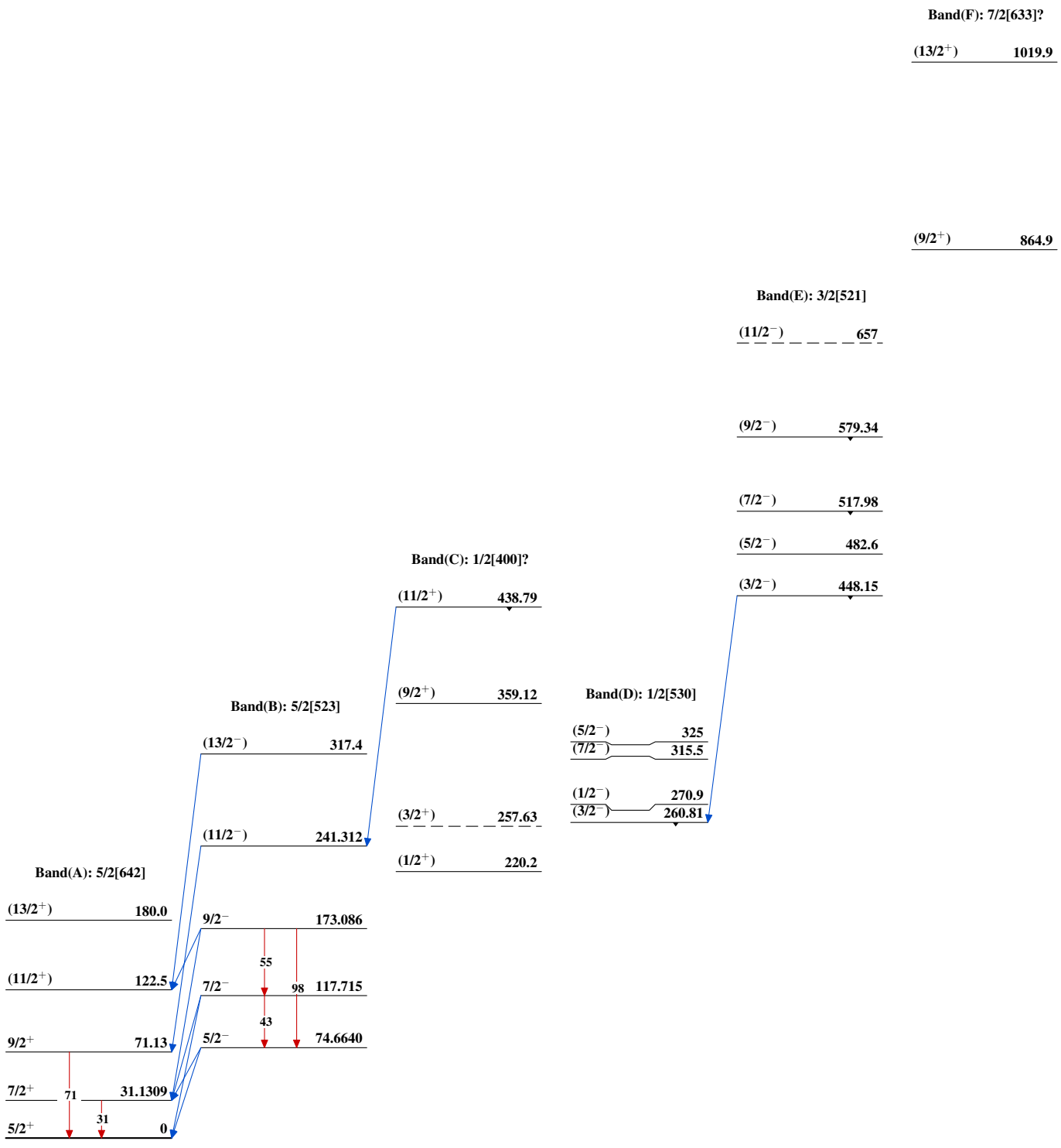
Adopted Levels, Gammas



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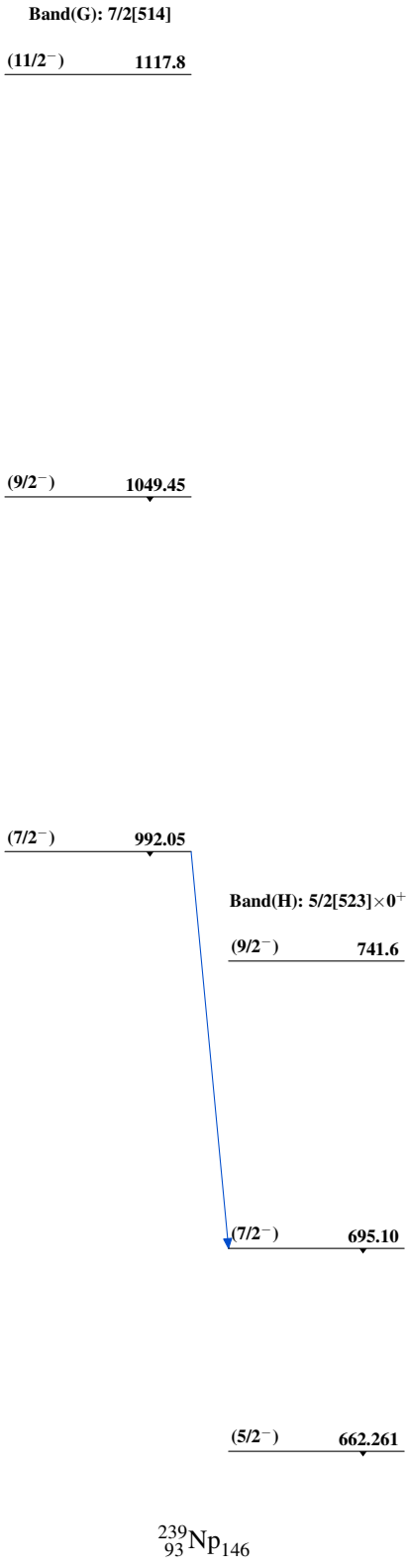
Adopted Levels, Gammas (continued)



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