Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 146, 1 (2017)	30-Sep-2017

Q(β^-)=−5950 *SY*; S(n)=9675 *28*; S(p)=1010 *50*; Q(α)=2560 *60* 2017Wa10
ΔQ(β^-)=200 (syst,2017Wa10).
S(2n)=21650 *200* (syst), S(2p)=5160 *70*, Q(εp)=5030 *30*, Q(β^+)=9750 *30* (2017Wa10).
First identification of ^{138}Eu nuclide by 1982No15 via ^{112}Sn(^{32}S,3p2n). The identification in an earlier report (1977Bo02) by the same group is incorrect according to 1982No15.
Other measurements:
Isotope shifts: 2004Ba93, 1992Le09, 1987Al25.
Nuclear moments: 1987AlZB, 1992Si22.
Additional information 1.
Nuclear structure calculations:
2013Sa57: calculated halflife.
2011Al12: calculated deformation parameters and tilt angles, energy splittings between chiral partner bands in the rotating frame.

^{138}Eu Levels

Cross Reference (XREF) Flags

A ^{138}Gd ε decay
B ^{92}Mo(^{50}Cr,n3pγ)
C ^{106}Cd(^{35}Cl,2pnγ)

E(level)†	Jπ‡	$T_{1/2}$	XREF	Comments
0.0	(6$^-$)	12.1 s *6*		%ε+%β^+=100 μ=5.3 *7* (1992Si22) Jπ: from comparison of measured μ with theoretical predictions for all possible configurations, among which only the ((π 5/2$^-$[532])(ν 7/2$^+$[404])) with J^π=6$^-$ gives a μ=4.3 in close agreement with the measured μ=5.3 *7* (1992Si22); J^π=6$^-$ is also supported by direct feeding to high-spin (J≥6) states in ^{138}Sm from ^{138}Eu ε decay. $T_{1/2}$: from γ(t) in 1985Ch25 (also 1986Re11 and 1987Pl05). Others: 12 s *2* (1982No15, X-ray(t)), 12 s *1* (1987Ke05, γ(t)). 1977Bo02 report two half-lives of 35 s *6* and 1.5 s *4* from the non-selective measurements of total β decay of the isobaric chain and assign them to the ^{138}Eu decay, which is incorrect according to their later report (1982No15) of half-life measurements using X rays. μ: from temperature-dependent curve of γ-ray anisotropy using the 686γ in ^{138}Sm from ^{138}Eu decay (1992Si22). See also 2014StZZ compilation. root-mean-square deformation parameter $<\beta^2>^{1/2}$=0.246 *8* (2004Ba93). Evaluated nuclear charge radius $<r^2>^{1/2}$=4.978 fm *10* (2013An02).
0.0+y	(1$^-$)		A	Additional information 2. Jπ: configuration=(π 5/2$^-$[532])(ν 7/2$^+$[404]) would give 6$^-$ and 1$^-$ states. Since 6$^-$ is assigned to the g.s., it is possible that this state has J^π=1$^-$; it is also supported by the direct feeding from ^{138}Gd g.s. ε decay, J^π(g.s.)=0$^+$.
64.70+y *20*			A	
293.0+y *3*			A	
297.5+y *4*			A	
310.7+y *4*			A	
356.4+y *3*			A	
376.0+y *4*			A	
584.8+y *3*			A	
0.0+x	(8$^+$)		B	Additional information 3.

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Adopted Levels, Gammas (continued)

^{138}Eu Levels (continued)

E(level)[†]	Jπ[‡]	XREF	Comments
105.12+x[@] *20*	(9+)	BC	Jπ: from 2001He15 in ^{106}Cd(^{35}Cl,2pnγ) based on systematics of neighbouring N=75 isotones for band-head spin (2001St04, 1998Li36, 1996Li13).
272.1+x[#] *3*	(10+)	BC	
545.4+x[@] *3*	(11+)	BC	
629.6+x[&] *6*	(10+)	C	
793.6+x[a] *6*	(11+)	C	
807.5+x[#] *3*	(12+)	BC	
1092.7+x[&] *6*	(12+)	C	
1169.9+x[@] *3*	(13+)	BC	
1443.6+x[a] *6*	(13+)	C	
1490.2+x[#] *3*	(14+)	BC	
1849.2+x[&] *7*	(14+)	C	
1917.5+x[@] *4*	(15+)	BC	
2044.5+x[b] *4*	(13−)	C	
2232.3+x[a] *7*	(15+)	C	
2286.2+x[b] *4*	(14−)	C	
2299.6+x[#] *4*	(16+)	BC	
2521.7+x[b] *4*	(15−)	C	
2710.2+x[&] *10*	(16+)	C	
2762.4+x[@] *4*	(17+)	C	
2780.3+x[b] *4*	(16−)	C	
3066.9+x[b] *4*	(17−)	C	
3129.3+x[a] *13*	(17+)	C	
3178.9+x[#] *4*	(18+)	C	
3347.1+x[c] *4*	(17−)	C	
3395.5+x[b] *4*	(18−)	C	
3590.4+x[@] *4*	(19+)	C	
3744.2+x[b] *4*	(19−)	C	
3780.5+x[c] *4*	(18−)	C	
4016.2+x[#] *4*	(20+)	C	
4141.0+x[b] *4*	(20−)	C	
4257.7+x[c] *4*	(19−)	C	
4456.9+x[@] *4*	(21+)	C	
4548.0+x[b] *4*	(21−)	C	
4751.0+x[c] *4*	(20−)	C	
4983.2+x[#] *4*	(22+)	C	
5010.6+x[b] *4*	(22−)	C	
5481.0+x[b] *21*	(23−)	C	
5486.8+x[@] *4*	(23+)	C	
6026.6+x[#] *5*	(24+)	C	
6632.3+x[@] *5*	(25+)	C	

[†] From a least-squares fit to γ-ray energies, assuming ΔEγ=1 keV if not given.

[‡] Based on γ(θ), γ multipolarities, band structures and systematics of neighbouring isotones in ^{106}Cd(^{35}Cl,2pnγ) for high-spin

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Adopted Levels, Gammas (continued)

^{138}Eu Levels (continued)

states, unless otherwise noted. The positive parity states follow the assignments from 2001He15, while the J values of the negative parity states are those from 1994Pa14, increased by one unit after private communication of the evaluator of 2003So13 with the author E.S.Paul. Note that the values reported by 1988Li29 in ^{92}Mo(^{50}Cr,2npγ) are lower by one unit than those in 2001He15 in ^{106}Cd(^{35}Cl,2pnγ) of the same group. It′s in the evaluator′s opinion that these assignments are not definite and further experimental studies are needed to confirm these assignments.

[#] Band(A): Band 1, $\pi h_{11/2}\otimes\nu h_{11/2}$, α=0.

[@] Band(a): Band 2, $\pi h_{11/2}\otimes\nu h_{11/2}$, α=1.

[&] Band(B): Band 3, $\pi h_{11/2}\otimes\nu h_{11/2}$, α=0.

[a] Band(b): Band 4, $\pi h_{11/2}\otimes\nu h_{11/2}$, α=1.

[b] Band(C): Band 5, possible negative band.

[c] Band(D): Band 6, possible negative band.

γ(^{138}Eu)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[#]	Comments
64.70+y		64.7 *2*	100	0.0+y	(1$^-$)		
293.0+y		228.3 *2*	100	64.70+y			
297.5+y		232.8 *3*	100	64.70+y			
310.7+y		246.0 *3*	100	64.70+y			
356.4+y		291.7 *2*	100	64.70+y			
376.0+y		311.3 *3*	100	64.70+y			
584.8+y		228.4 *3*		356.4+y			
		520.1 *3*		64.70+y			
105.12+x	(9$^+$)	105.1 *2*	100	0.0+x	(8$^+$)	M1+E2	E_γ: weighted average of 105.2 *3* from ^{92}Mo(^{50}Cr,2npγ) and 105.0 *2* from ^{106}Cd(^{35}Cl,2pnγ).
272.1+x	(10$^+$)	167.0 *2*	100	105.12+x	(9$^+$)	M1+E2	E_γ: weighted average of 167.1 *3* from ^{92}Mo(^{50}Cr,2npγ) and 167.0 *2* from ^{106}Cd(^{35}Cl,2pnγ).
545.4+x	(11$^+$)	273.3 *2*	100[‡] *7*	272.1+x	(10$^+$)	M1+E2	E_γ: weighted average of 273.2 *3* from ^{92}Mo(^{50}Cr,2npγ) and 273.3 *2* from ^{106}Cd(^{35}Cl,2pnγ).
		440.3[@‡] *3*	24.1[@‡] *17*	105.12+x	(9$^+$)	(E2)	I_γ: other: 8.2 from ^{106}Cd(^{35}Cl,2pnγ) (1994Pa14).
629.6+x	(10$^+$)	524		105.12+x	(9$^+$)		
		630		0.0+x	(8$^+$)		
793.6+x	(11$^+$)	164		629.6+x	(10$^+$)		
		522		272.1+x	(10$^+$)		
		688		105.12+x	(9$^+$)		
807.5+x	(12$^+$)	262.2 *2*	100[‡] *7*	545.4+x	(11$^+$)	M1+E2	E_γ: weighted average of 262.1 *3* from ^{92}Mo(^{50}Cr,2npγ) and 262.2 *2* from ^{106}Cd(^{35}Cl,2pnγ).
		535.3 *2*	86[‡] *7*	272.1+x	(10$^+$)	E2	E_γ: weighted average of 535.3 *3* from ^{92}Mo(^{50}Cr,2npγ) and 535.3 *2* from ^{106}Cd(^{35}Cl,2pnγ). I_γ: 44.3 from ^{106}Cd(^{35}Cl,2pnγ).
1092.7+x	(12$^+$)	299		793.6+x	(11$^+$)		
		463		629.6+x	(10$^+$)		
		547		545.4+x	(11$^+$)		
1169.9+x	(13$^+$)	362.6 *2*	100[‡] *5*	807.5+x	(12$^+$)	M1+E2	E_γ: weighted average of 362.3 *3* from ^{92}Mo(^{50}Cr,2npγ) and 362.7 *2* from ^{106}Cd(^{35}Cl,2pnγ).
		624.6 *2*	50[‡] *5*	545.4+x	(11$^+$)		E_γ: weighted average of 624.4 *3* from

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Adopted Levels, Gammas (continued)

γ(^{138}Eu) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[#]	Comments
							^{92}Mo(^{50}Cr,2npγ) and 624.7 *2* from ^{106}Cd(^{35}Cl,2pnγ).
							I_γ: 56.5 from ^{106}Cd(^{35}Cl,2pnγ).
1443.6+x	(13$^+$)	351		1092.7+x	(12$^+$)		
		650		793.6+x	(11$^+$)		
		897		545.4+x	(11$^+$)		
1490.2+x	(14$^+$)	320.3 *2*	83[‡] *42*	1169.9+x	(13$^+$)	M1+E2	E_γ: weighted average of 320.2 *3* from ^{92}Mo(^{50}Cr,2npγ) and 320.4 *2* from ^{106}Cd(^{35}Cl,2pnγ).
							I_γ: 8.9 from ^{106}Cd(^{35}Cl,2pnγ).
		682.6 *2*	100[‡] *8*	807.5+x	(12$^+$)	E2	E_γ: weighted average of 682.5 *3* from ^{92}Mo(^{50}Cr,2npγ) and 682.6 *2* from ^{106}Cd(^{35}Cl,2pnγ).
1849.2+x	(14$^+$)	405		1443.6+x	(13$^+$)		
		680		1169.9+x	(13$^+$)		
		756		1092.7+x	(12$^+$)		
1917.5+x	(15$^+$)	427.5 *2*	100[‡] *9*	1490.2+x	(14$^+$)	M1+E2	E_γ: weighted average of 427.2 *3* from ^{92}Mo(^{50}Cr,2npγ) and 427.7 *2* from ^{106}Cd(^{35}Cl,2pnγ).
							I_γ: 54.0 from ^{106}Cd(^{35}Cl,2pnγ).
		747.4 *2*	91[‡] *46*	1169.9+x	(13$^+$)		E_γ: weighted average of 747.4 *3* from ^{92}Mo(^{50}Cr,2npγ) and 747.4 *2* from ^{106}Cd(^{35}Cl,2pnγ).
							I_γ: 100 from ^{106}Cd(^{35}Cl,2pnγ).
2044.5+x	(13$^-$)	1237.0 *2*	100	807.5+x	(12$^+$)		
2232.3+x	(15$^+$)	383		1849.2+x	(14$^+$)		
		743		1490.2+x	(14$^+$)		
		788		1443.6+x	(13$^+$)		
		1060[&]		1169.9+x	(13$^+$)		
2286.2+x	(14$^-$)	241.5 *2*	21.9	2044.5+x	(13$^-$)		
		1116.5 *2*	100.0	1169.9+x	(13$^+$)	(E1)	
2299.6+x	(16$^+$)	382.3 *2*	19.4	1917.5+x	(15$^+$)	M1+E2	E_γ: weighted average of 382.1 *3* from ^{92}Mo(^{50}Cr,2npγ) and 382.4 *2* from ^{106}Cd(^{35}Cl,2pnγ).
							I_γ: <45 from ^{92}Mo(^{50}Cr,2npγ).
		809.2 *2*	100.0	1490.2+x	(14$^+$)	E2	E_γ: weighted average of 809.3 *3* from ^{92}Mo(^{50}Cr,2npγ) and 809.1 *2* from ^{106}Cd(^{35}Cl,2pnγ).
2521.7+x	(15$^-$)	235.4 *2*	100.0	2286.2+x	(14$^-$)	M1+E2	
		477.4[@] *2*	20.8[@]	2044.5+x	(13$^-$)		
		1031.6 *2*	93.8	1490.2+x	(14$^+$)	(E1)	
2710.2+x	(16$^+$)	478		2232.3+x	(15$^+$)		
		861		1849.2+x	(14$^+$)		
2762.4+x	(17$^+$)	462.8 *2*	28.3	2299.6+x	(16$^+$)	M1+E2	
		844.9 *2*	100.0	1917.5+x	(15$^+$)	E2	
2780.3+x	(16$^-$)	258.7 *2*	100.0	2521.7+x	(15$^-$)		
		494.1 *2*	27.8	2286.2+x	(14$^-$)	E2	
		862.5 *2*	3.3	1917.5+x	(15$^+$)		
3066.9+x	(17$^-$)	286.6 *2*	100.0	2780.3+x	(16$^-$)		
		545.5 *2*	42.0	2521.7+x	(15$^-$)		
3129.3+x	(17$^+$)	420[&]		2710.2+x	(16$^+$)		
		897		2232.3+x	(15$^+$)		
3178.9+x	(18$^+$)	416.7 *2*	11.5	2762.4+x	(17$^+$)		

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Adopted Levels, Gammas (continued)

γ(^{138}Eu) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[#]	Comments
3178.9+x	(18$^+$)	879.0 *2*	100.0	2299.6+x	(16$^+$)	E2	
3347.1+x	(17$^-$)	1047.6 *2*	100.0	2299.6+x	(16$^+$)		
3395.5+x	(18$^-$)	328.4 *2*	100.0	3066.9+x	(17$^-$)		
		614.9 *2*	64.8	2780.3+x	(16$^-$)		
3590.4+x	(19$^+$)	411.8 *2*	57.7	3178.9+x	(18$^+$)		
		827.6 *2*	100.0	2762.4+x	(17$^+$)		
3744.2+x	(19$^-$)	348.5 *2*	22.2	3395.5+x	(18$^-$)		
		677.6 *2*	100.0	3066.9+x	(17$^-$)		
3780.5+x	(18$^-$)	435.1 *2*	11.1	3347.1+x	(17$^-$)		E_γ: poor-fit; uncertainty was increased to $\Delta E\gamma$=0.6 keV in the fitting procedure. Level-energy difference=433.40.
		1018.4 *2*	100.0	2762.4+x	(17$^+$)	(E1)	
4016.2+x	(20$^+$)	426.0 *2*	82.1	3590.4+x	(19$^+$)	M1+E2	
		837.4 *2*	100.0	3178.9+x	(18$^+$)		
4141.0+x	(20$^-$)	396.9 *2*	52.8	3744.2+x	(19$^-$)		
		745.4 *2*	100.0	3395.5+x	(18$^-$)		
4257.7+x	(19$^-$)	477.4[@] *2*	21.6[@]	3780.5+x	(18$^-$)		
		910.6 *2*	43.1	3347.1+x	(17$^-$)		
		1078.3 *2*	100.0	3178.9+x	(18$^+$)	(E1)	
4456.9+x	(21$^+$)	440.5[@] *2*	27.3[@]	4016.2+x	(20$^+$)	(M1+E2)	
		866.2 *2*	100.0	3590.4+x	(19$^+$)		
4548.0+x	(21$^-$)	406.9 *2*	35.0	4141.0+x	(20$^-$)		
		804.0 *2*	100	3744.2+x	(19$^-$)		
4751.0+x	(20$^-$)	493.0 *2*	<17	4257.7+x	(19$^-$)		
		970.9 *2*	100	3780.5+x	(18$^-$)		
4983.2+x	(22$^+$)	526.4 *2*	<16	4456.9+x	(21$^+$)		
		967.4 *2*	100	4016.2+x	(20$^+$)		
5010.6+x	(22$^-$)	462.6 *2*	<59	4548.0+x	(21$^-$)		
		869.5 *2*	100	4141.0+x	(20$^-$)		
5481.0+x	(23$^-$)	933 *2*	100	4548.0+x	(21$^-$)		
5486.8+x	(23$^+$)	504.2 *2*	<7	4983.2+x	(22$^+$)		
		1029.4 *2*	100	4456.9+x	(21$^+$)		
6026.6+x	(24$^+$)	1043.4 *2*	100	4983.2+x	(22$^+$)		
6632.3+x	(25$^+$)	1145.5 *2*	100	5486.8+x	(23$^+$)		

[†] From ^{106}Cd(^{35}Cl,2pnγ) with errors estimated to typically ≤5% (1994Pa14), unless otherwise noted.
[‡] From ^{92}Mo(^{50}Cr,2npγ) (1988Li29).
[#] From 1994Pa14 in ^{106}Cd(^{35}Cl,2pnγ) based on γ(DCO).
[@] Multiply placed with intensity suitably divided.
[&] Placement of transition in the level scheme is uncertain.

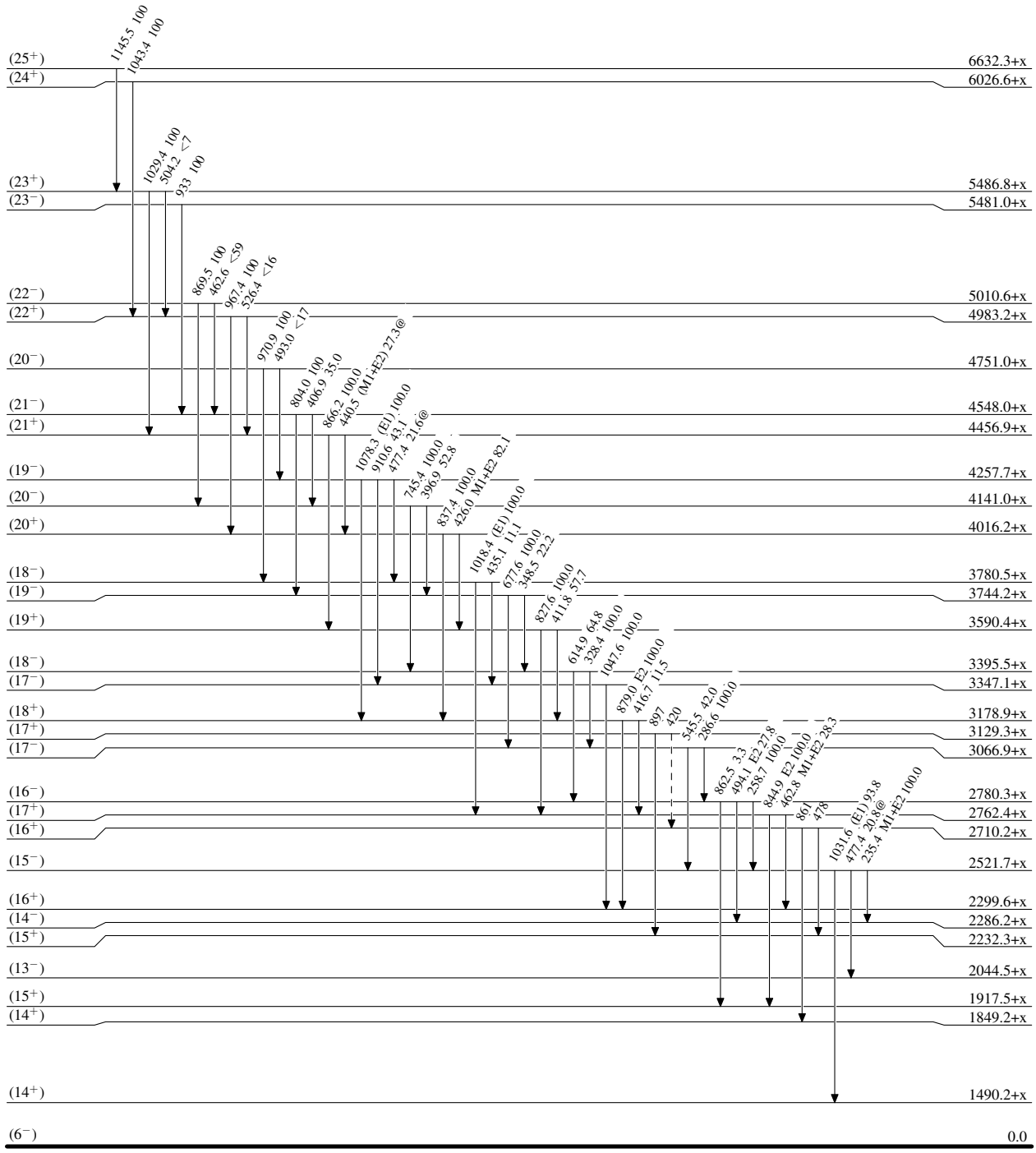
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level
@ Multiply placed: intensity suitably divided

γ Decay (Uncertain)



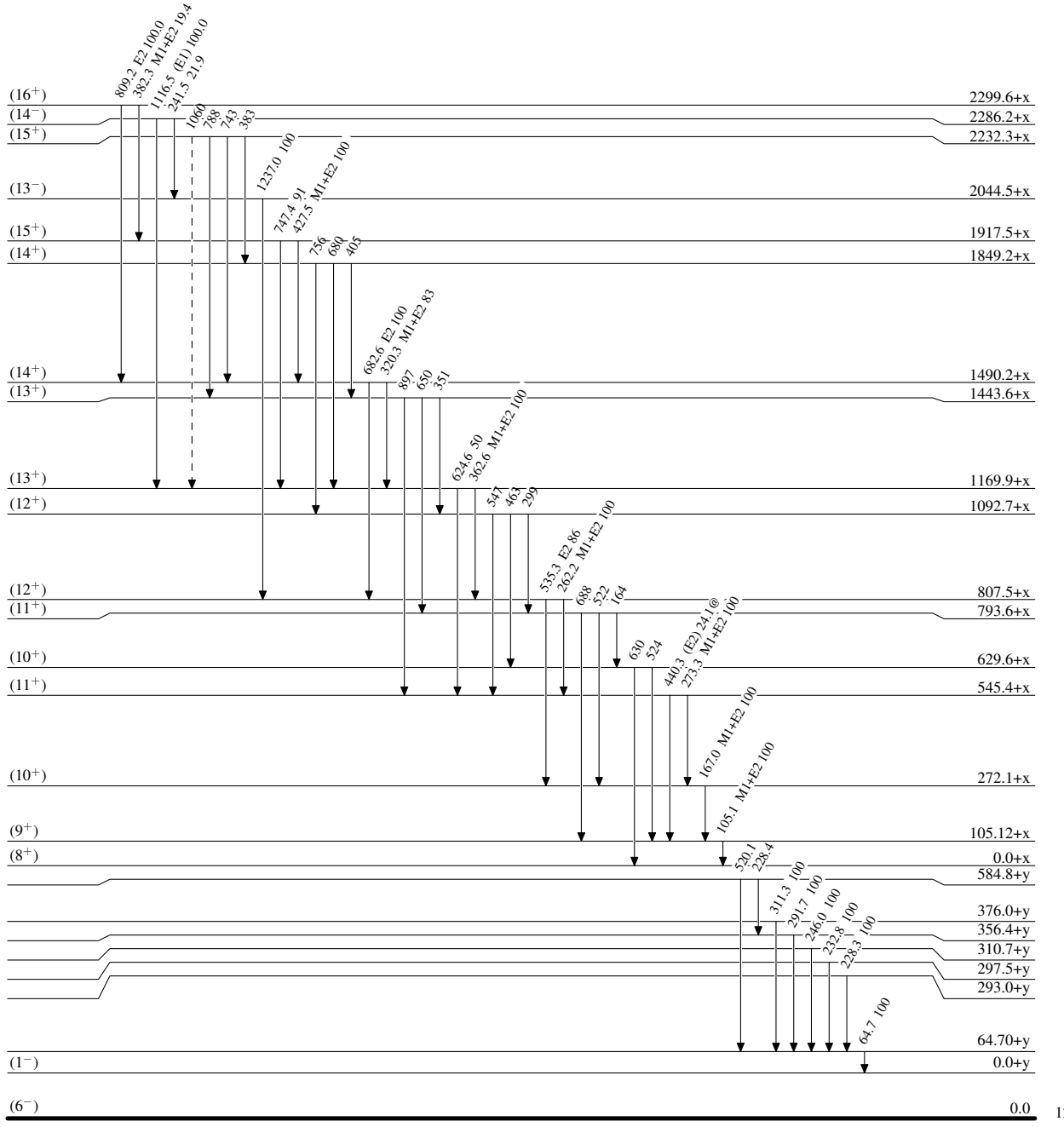
Adopted Levels, Gammas

Legend

Level Scheme (continued)

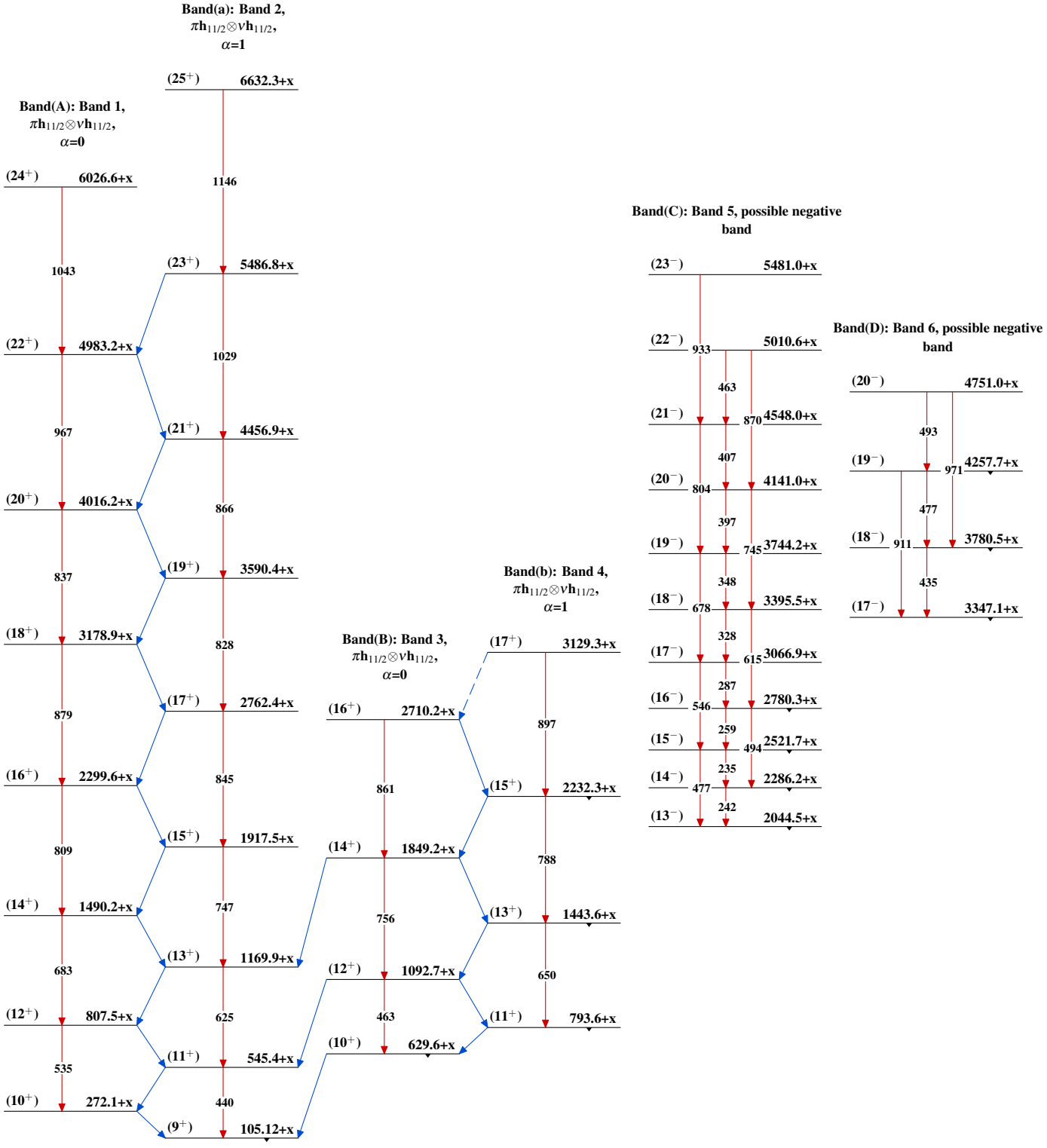
Intensities: Relative photon branching from each level
@ Multiply placed: intensity suitably divided

γ Decay (Uncertain)



$^{138}_{63}Eu_{75}$

Adopted Levels, Gammas



$^{138}_{63}Eu_{75}$