Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	P. K. Joshi, B. Singh, S. Singh, A. K. Jain	NDS 138, 1 (2016)	15-Oct-2016

Q(β^-)=5057 *4*; S(n)=3744 *4*; S(p)=10954 *6*; Q(α)=−342 *3* 2012Wa38
S(2n)=9403.8 *21*, S(2p)=20918 *3* (2012Wa38).
2012Va02: precise mass measurement.
2007Ji14, 2006Ks01: theoretical calculations of level properties.

^{139}Xe Levels

Cross Reference (XREF) Flags

A	^{139}I β^- decay (2.280 s)	D	^{252}Cf SF decay
B	^{140}I β^-n decay (0.86 s)	E	^{235}U(n,Fγ)
C	^{248}Cm SF decay		

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$[#]	XREF	Comments
0.0	3/2$^-$	39.68 s *14*	ABCDE	%β^-=100 μ=−0.304 *10* (1989Bo03,2014StZZ) Q=+0.39 *2* (1989Bo03,2016St14) RMS charge radius <r^2>$^{1/2}$=4.841 fm *10* (2013An02 evaluation). J$^\pi$: spin from atomic beam laser spectroscopy (1989Bo03); parity from log *ft*<11 for β decay to 7/2$^+$. T$_{1/2}$: from weighted average of values for five γ rays (175, 218, 289, 296, 393) in the decay of ^{139}Xe (1969Ca03), systematic uncertainty is included in the weighted average. (Individual values in seconds in 1969Ca03: 39.69 *3*, 39.72 *5*, 39.81 *21*, 39.48 *13*, 39.12 *27*). Others: 40.8 s *7* (1974Gr29), 39.7 s *8* (1971Kr22), 39.3 s *9* (1970OsZZ), 39.3 s *7* (1968Al06), 41.30 s *15* (1966Ar08,from time decay of β spectrum, not considered in the recommended value due to the presence of several longer-lived impurities in the β decay curve), 40.4 s *13* (1965Pa14), 41 s *2* (1962Wa34), 41 s (1950Di01), ≈30 s (F.A. Heyn et al., Nature 143, 516 (1939)). μ,Q: collinear fast beam laser spectroscopy (1989Bo03). Q=+0.40 in 1989Bo03 re-evaluated to +0.39 in 2016St14.
22.74[e] *8*	(7/2$^-$)[&][c]		A CDE	
31.703[f] *20*	(5/2$^-$)[&][c]		A CD	
559.43[f] *9*	(9/2$^-$)[c]		A CD	
593.96[e] *9*	(11/2$^-$)[b]		A CDE	
624.26 *9*	(5/2$^-$)[&]		A	
670.02 *12*	(3/2$^-$,5/2,7/2$^-$)[d]		A	
678.75[g] *9*	(9/2$^-$)		A C	
1008.27 *10*	(5/2,7/2,9/2)		A	
1059.02 *15*	(3/2$^-$,5/2,7/2)[d]		A	
1086.20[g] *19*	(13/2$^-$)[c]		CD	
1179.34[e] *12*	(15/2$^-$)[c]		CDE	
1193.33 *11*	(3/2$^-$,5/2,7/2)		A	
1194.70[f] *13*	(13/2$^-$)		C	
1312.70 *16*			A	
1399.47 *10*	(3/2$^-$,5/2,7/2)[d]		A	
1418.02 *14*	(11/2$^+$)		C	
1444.14 *13*	(7/2,9/2)[@]		A	

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{139}Xe Levels (continued)

E(level)†	Jπ‡	XREF	E(level)†	Jπ‡	XREF	E(level)†	Jπ‡	XREF
1448.52 *11*	(7/2,9/2)@	A	2307.93 *13*		A	3585.9g *3*	(29/2−)bc	CD
1493.35 *16*		A	2500.01e *18*	(23/2−)c	CD	3607.7 *4*		D
1512.35h *17*	(13/2+)ac	CD	2574.98h *18*	(21/2+)ac	CD	3792.81h *23*	(29/2+)c	CD
1576.91g *15*	(17/2−)c	CD	2740.18 *14*		A	4022.9e *3*	(31/2−)c	CD
1684.04 *9*	(5/2,7/2,9/2)	A	2898.45 *12*		A	4232.4g *3*	(33/2−)bc	CD
1771.43 *9*		A	2921.68g *21*	(25/2−)bc	CD	4298.9 *4*		C
1809.73e *15*	(19/2−)c	CDE	2925.37 *21*		CD	4412.4h *3*	(33/2+)c	D
1861.95f *16*	(17/2−)	C	2993.78 *24*		C	4984.9?e *5*	(35/2−)c	D
1894.43 *15*		A	3161.47e *20*	(27/2−)c	CD	5096.3g *4*	(37/2−)c	CD
2014.50h *15*	(17/2+)ac	CD	3211.71h *21*	(25/2+)ac	CD	6091.3?g *5*	(41/2−)c	D
2158.70g *17*	(21/2−)c	CD	3305.1 *3*		D			
2192.82 *19*	(19/2−)c	CD	3547.9 *3*	(27/2+)c	CD			

† From least-squares fit to Eγ data, ΔEγ=0.2 keV assumed when not given. Reduced χ^2=2.0 is somewhat larger than critical χ^2=1.5. The 849.5 and 969.4 gamma rays deviate by about 3 σ values.

‡ From γγ(θ) and directional polarization in ^{248}Cm SF decay and assumption that, since fission predominately populates yrast states, the J values generally increase with excitation energy (2002Ur04). Also it is assumed that transitions of unknown multipolarity are dipole or E2; M2 is not allowed from estimated T<10 ns for levels populated in ^{248}Cm SF decay.

From γ(t), $T_{1/2}$<10 ns for excited states in ^{248}Cm SF decay (2002Ur04).

@ Gammas to (5/2−) and (11/2−).

& From systematics of N=85 isotones.

a From ΔJ=1 cascade and that the 13/2 state is non-yrast and is populated in fission suggesting opposite parity to the 13/2−.

b 1997Zh23 propose π=+ in ^{252}Cf SF decay.

c From 2002Lu08 based on band structure, previous assignments for low lying levels and decay pattern with the assumption of ascending spins with excitation energy. These differ from those suggested by 1997Zh23 in ^{252}Cf SF decay for the 1085.8 and higher states.

d Gammas to 3/2− and (7/2−); ≠3/2+ from log *ft*<11 from (7/2+) in ^{139}I β- decay.

e Band(A): Band based on (7/2−).

f Band(B): Band based on 5/2−.

g Band(C): Band based on 9/2−.

h Band(D): Band based on 13/2+.

Adopted Levels, Gammas (continued)

γ(^{139}Xe)

See ^{139}I β$^-$ decay for many unplaced gammas.

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡]	δ	α[#]	Comments
22.74	(7/2$^-$)	(22.8 *2*)		0.0	3/2$^-$	[E2]		694	α(L)=550 *8*; α(M)=118.5 *17*; α(N)=23.1 *4*; α(O)=2.16 *3* Obscured by x rays and 31.7γ in β$^-$ decay. Mult.: [E2] leads to an intensity balancing problem for the 22.8 level in β$^-$ decay.
31.703	(5/2$^-$)	31.70 *2*	100	0.0	3/2$^-$	M1+E2	≈0.9	≈62.5	α(L)=6.E1 6; α(M)=12 *12*; α(N)=2.3 *23*; α(O)=0.22 *21* Mult.,δ: from ^{139}I β$^-$ decay.
559.43	(9/2$^-$)	527.81 *14*	100 *3*	31.703	(5/2$^-$)	E2			
		536.80 *14*	67 *2*	22.74	(7/2$^-$)				
593.96	(11/2$^-$)	571.13 *10*	100	22.74	(7/2$^-$)	E2		0.00625 *9*	
624.26	(5/2$^-$)	592.6 *2*	100 *3*	31.703	(5/2$^-$)				
		601.5 *2*	76 *3*	22.74	(7/2$^-$)				
		624.3 *2*	6.2 *3*	0.0	3/2$^-$				
670.02	(3/2$^-$,5/2,7/2$^-$)	638.5 *2*	100 *3*	31.703	(5/2$^-$)				
		647.1[@] *2*		22.74	(7/2$^-$)				
		670.4 *2*	46.9 *16*	0.0	3/2$^-$				
678.75	(9/2$^-$)	84.80 *2*	3.45 *17*	593.96	(11/2$^-$)	[M1,E2]		2.3 *10*	α(K)=1.6 *5*; α(L)=0.6 *5*; α(M)=0.12 *10*; α(N)=0.024 *19*; α(O)=0.0025 *18*
		646.85 *25*	24.5 *9*	31.703	(5/2$^-$)				
		655.9 *2*	100 *3*	22.74	(7/2$^-$)				
1008.27	(5/2,7/2,9/2)	329.6 *2*	2.2 *2*	678.75	(9/2$^-$)				
		384.0 *2*	1.8 *2*	624.26	(5/2$^-$)				
		448.9 *2*	2.4 *2*	559.43	(9/2$^-$)				
		976.4 *2*	100 *4*	31.703	(5/2$^-$)				
		985.4 *2*	36 *2*	22.74	(7/2$^-$)				
1059.02	(3/2$^-$,5/2,7/2)	389.1[@] *2*	35 *1*	670.02	(3/2$^-$,5/2,7/2$^-$)				
		1027.3 *2*	13.6 *5*	31.703	(5/2$^-$)				
		1036.3 *2*	100 *5*	22.74	(7/2$^-$)				
		1059.4[@] *2*	7.7 *5*	0.0	3/2$^-$				
1086.20	(13/2$^-$)	407.8	24 *4*	678.75	(9/2$^-$)				E_γ,I_γ: γ from ^{248}Cm SF decay only.
		491.3 *5*	100 *12*	593.96	(11/2$^-$)	(M1+E2)			E_γ: unweighted average of the two values.
		525.8 *6*	12 *4*	559.43	(9/2$^-$)				E_γ: unweighted average of the two values.
1179.34	(15/2$^-$)	585.34 *10*	100	593.96	(11/2$^-$)	(E2)			
1193.33	(3/2$^-$,5/2,7/2)	1161.4 *2*	100 *3*	31.703	(5/2$^-$)				
		1170.4 *2*	37 *1*	22.74	(7/2$^-$)				
		1193.3 *2*	41 *1*	0.0	3/2$^-$				
1194.70	(13/2$^-$)	516.0	17 *8*	678.75	(9/2$^-$)				

$^{139}_{54}Xe_{85}$-3

Adopted Levels, Gammas (continued)

γ(^{139}Xe) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡]	α[#]	Comments
1194.70	(13/2⁻)	600.5	100 *33*	593.96	(11/2⁻)			
		635.5	50 *17*	559.43	(9/2⁻)			
1312.70		634.0[@] *2*	62 *4*	678.75	(9/2⁻)			
		719.1 *2*	100 *4*	593.96	(11/2⁻)			
		752.9 *2*	58 *4*	559.43	(9/2⁻)			
1399.47	(3/2⁻,5/2,7/2)	730.0 *2*	85 *3*	670.02	(3/2⁻,5/2,7/2⁻)			
		774.1[@] *2*	100 *3*	624.26	(5/2⁻)			
		1367.4 *2*	79 *3*	31.703	(5/2⁻)			
		1376.9 *2*	68 *3*	22.74	(7/2⁻)			
		1399.6 *2*	44.1 *15*	0.0	3/2⁻			
1418.02	(11/2⁺)	739.0	58 *25*	678.75	(9/2⁻)			
		824.2	100 *33*	593.96	(11/2⁻)			
		858.7	83 *42*	559.43	(9/2⁻)			
1444.14	(7/2,9/2)	849.5 *2*	24.6 *8*	593.96	(11/2⁻)			E_γ: poor fit, level-energy difference=850.2.
		1412.6 *2*	100 *3*	31.703	(5/2⁻)			
		1421.9 *2*	32.3 *15*	22.74	(7/2⁻)			
1448.52	(7/2,9/2)	440.0 *2*	1.2 *2*	1008.27	(5/2,7/2,9/2)			
		769.8 *2*	26.0 *8*	678.75	(9/2⁻)			
		824.8 *2*	6.0 *2*	624.26	(5/2⁻)			
		854.4 *2*	100 *4*	593.96	(11/2⁻)			
		1425.6 *2*	28.0 *8*	22.74	(7/2⁻)			
1493.35		899.4 *2*	30.9 *23*	593.96	(11/2⁻)			
		933.9 *2*	100 *2*	559.43	(9/2⁻)			
1512.35	(13/2⁺)	918.41 *17*	100	593.96	(11/2⁻)	D		
1576.91	(17/2⁻)	397.52 *11*	100 *8*	1179.34	(15/2⁻)	M1+E2	0.0186 *12*	
		491.3 *5*	54 *8*	1086.20	(13/2⁻)	(E2)		E_γ: unweighted average of the two values.
1684.04	(5/2,7/2,9/2)	675.7 *2*	4.0 *5*	1008.27	(5/2,7/2,9/2)			
		1005.6 *2*	26 *1*	678.75	(9/2⁻)			
		1124.5 *2*	9.0 *5*	559.43	(9/2⁻)			
		1652.5 *2*	22 *1*	31.703	(5/2⁻)			
		1661.5 *2*	100 *5*	22.74	(7/2⁻)			
1771.43		87.40 *2*	50 *5*	1684.04	(5/2,7/2,9/2)			
		763.3 *2*	100 *5*	1008.27	(5/2,7/2,9/2)			
		1146.9 *2*	90 *8*	624.26	(5/2⁻)			
		1212.2 *2*	45 *5*	559.43	(9/2⁻)			
1809.73	(19/2⁻)	232.79 *20*	12 *3*	1576.91	(17/2⁻)			
		630.38 *10*	100 *9*	1179.34	(15/2⁻)	(E2)		
1861.95	(17/2⁻)	667.3	25 *13*	1194.70	(13/2⁻)			
		682.5	100 *25*	1179.34	(15/2⁻)			
1894.43		1862.8 *2*	100 *3*	31.703	(5/2⁻)			
		1871.6 *2*	11 *3*	22.74	(7/2⁻)			
2014.50	(17/2⁺)	152.5	14 *4*	1861.95	(17/2⁻)			E_γ,I_γ: γ from ^{248}Cm SF decay only.
		502.17 *20*	14 *3*	1512.35	(13/2⁺)			

Adopted Levels, Gammas (continued)

γ(^{139}Xe) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡]	Comments
2014.50	(17/2$^+$)	835.16 *14*	100 *13*	1179.34	(15/2$^-$)	D	
2158.70	(21/2$^-$)	348.99 *20*	47 *7*	1809.73	(19/2$^-$)	D	I_γ: from ^{248}Cm SF decay. Other: 14 *6* from ^{252}Cf SF decay seems discrepant.
		581.78 *12*	100 *10*	1576.91	(17/2$^-$)	(E2)	
2192.82	(19/2$^-$)	383.0 *3*	45 *14*	1809.73	(19/2$^-$)		E_γ: unweighted average of the two values.
		1013.6 *2*	100 *25*	1179.34	(15/2$^-$)		
2307.93		859.4 *2*	86.4 *23*	1448.52	(7/2,9/2)		
		1628.7 *2*	≤23	678.75	(9/2$^-$)		
		1714.1 *2*	40.9 *23*	593.96	(11/2$^-$)		
		1748.8 *2*	100.0 *23*	559.43	(9/2$^-$)		
2500.01	(23/2$^-$)	341.3 *2*	27 *10*	2158.70	(21/2$^-$)	D	
		690.23 *14*	100 *10*	1809.73	(19/2$^-$)	(E2)	
2574.98	(21/2$^+$)	416.3	14 *7*	2158.70	(21/2$^-$)		E_γ,I_γ: γ from ^{248}Cm SF decay only.
		560.45 *21*	100 *14*	2014.50	(17/2$^+$)	(Q)	
		765.24 *20*	86 *15*	1809.73	(19/2$^-$)	D	I_γ: from ^{248}Cm SF decay. Other: 200 *82* in ^{252}Cf SF decay.
2740.18		969.4 *2*	57.9 *13*	1771.43			E_γ: poor fit, level-energy difference=968.8.
		1546.4 *2*	100 *3*	1193.33	(3/2$^-$,5/2,7/2)		
		2115.7 *2*	89.5 *26*	624.26	(5/2$^-$)		
2898.45		1499.5 *2*	≤50	1399.47	(3/2$^-$,5/2,7/2)		
		2866.5 *2*	100 *5*	31.703	(5/2$^-$)		
		2898.1 *2*	100 *5*	0.0	3/2$^-$		
2921.68	(25/2$^-$)	763.02 *14*	100	2158.70	(21/2$^-$)		
2925.37		425.1 *3*		2500.01	(23/2$^-$)		E_γ: γ from ^{252}Cf SF decay only.
		732.63 *19*	100 *10*	2192.82	(19/2$^-$)		
		1115.7 *3*	44 *9*	1809.73	(19/2$^-$)		E_γ,I_γ: γ from ^{252}Cf SF decay only.
2993.78		835.0	100	2158.70	(21/2$^-$)		
3161.47	(27/2$^-$)	661.51 *12*	100	2500.01	(23/2$^-$)		
3211.71	(25/2$^+$)	636.72 *18*	100 *24*	2574.98	(21/2$^+$)		
		711.51 *22*	92 *34*	2500.01	(23/2$^-$)	D	
3305.1		805.04 *22*	100	2500.01	(23/2$^-$)		
3547.9	(27/2$^+$)	554.0	48 *24*	2993.78			E_γ,I_γ: γ from ^{248}Cm SF decay only.
		626.32 *25*	100 *32*	2921.68	(25/2$^-$)		
3585.9	(29/2$^-$)	664.21 *14*	100	2921.68	(25/2$^-$)		
3607.7		682.30 *26*	100	2925.37			
3792.81	(29/2$^+$)	580.97 *18*	100 *56*	3211.71	(25/2$^+$)		
		631.5	111 *56*	3161.47	(27/2$^-$)		E_γ,I_γ: γ from ^{248}Cm SF decay only.
4022.9	(31/2$^-$)	861.45 *18*	100	3161.47	(27/2$^-$)		
4232.4	(33/2$^-$)	646.52 *13*	100	3585.9	(29/2$^-$)		
4298.9		713.0	100	3585.9	(29/2$^-$)		
4412.4	(33/2$^+$)	619.63 *15*		3792.81	(29/2$^+$)		
4984.9?	(35/2$^-$)	962.0[@] *4*		4022.9	(31/2$^-$)		
5096.3	(37/2$^-$)	863.89 *14*	100	4232.4	(33/2$^-$)		
6091.3?	(41/2$^-$)	995.0[@] *4*		5096.3	(37/2$^-$)		

$^{139}_{54}Xe_{85}$-5

Adopted Levels, Gammas (continued)

$\gamma(^{139}Xe)$ (continued)

† From ^{139}I β^- decay for low-spin (≤9/2) states and from SF decays for high-spin (>9/2) states. Weighted averages of the values from different studies taken when data are available, with uncertainty of 0.2 keV used for values from ^{248}Cm SF decay where these are not stated.

‡ From $\gamma\gamma(\theta)$ and γ(lin pol) in ^{248}Cm SF decay, except as stated. Also comparison to RUL from a comment by 2002Ur04 in ^{238}Cm SF decay that $T_{1/2}$<10 ns for all excited states, which excludes M2 for Eγ<700 keV 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.

@ Placement of transition in the level scheme is uncertain.

$^{139}_{54}Xe_{85}$-6

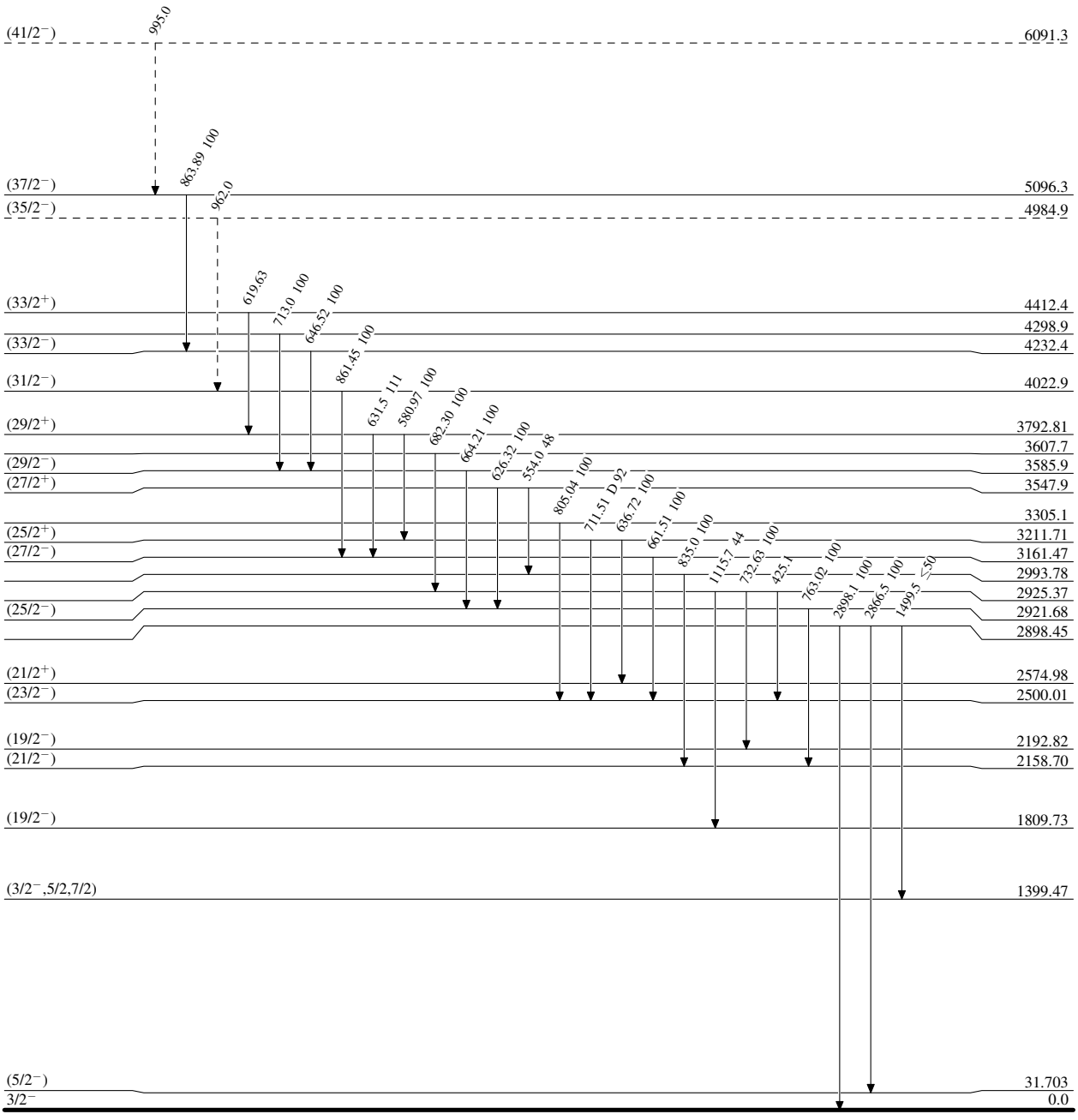
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

γ Decay (Uncertain)

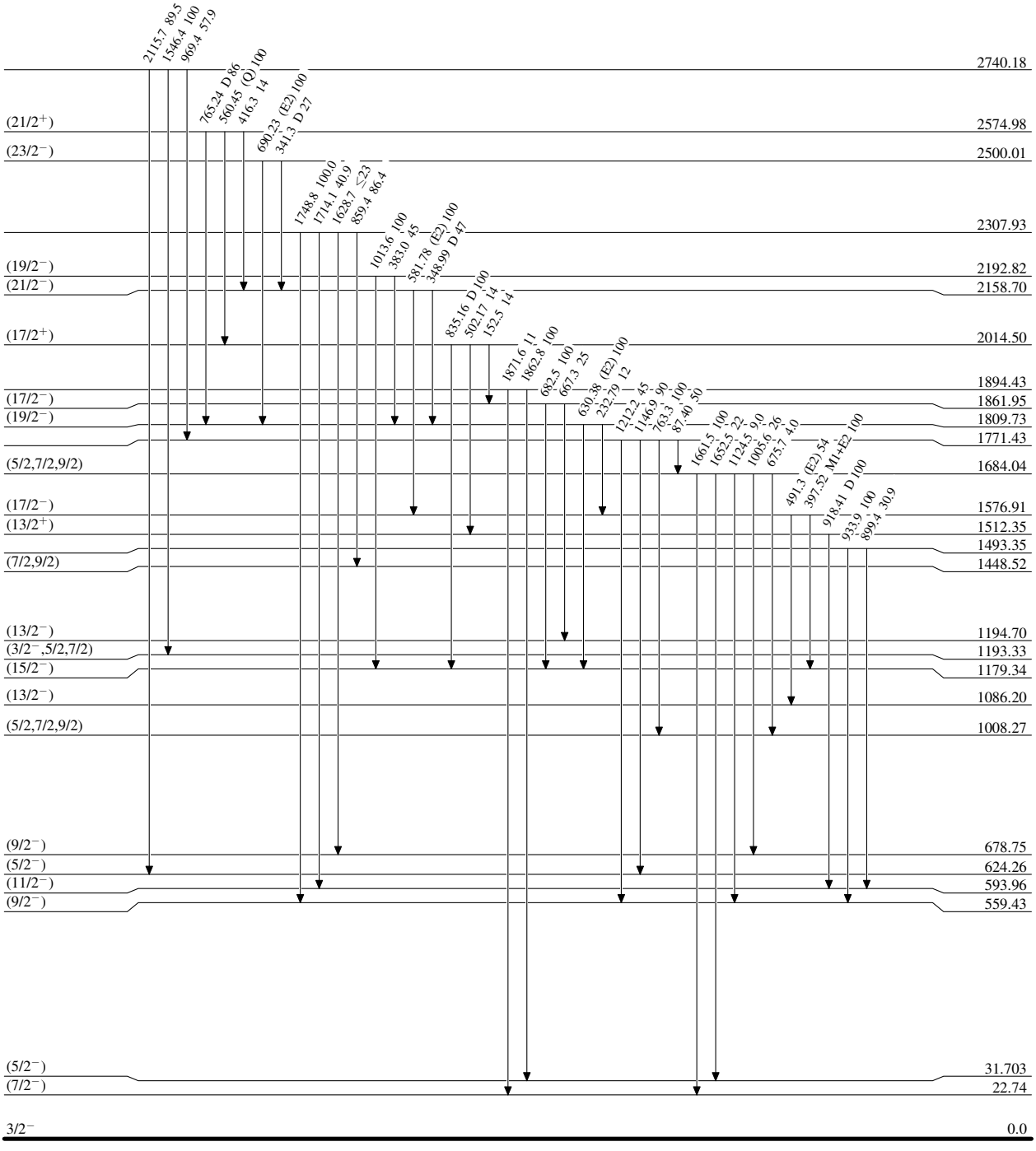


$^{139}_{54}Xe_{85}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{139}_{54}Xe_{85}$

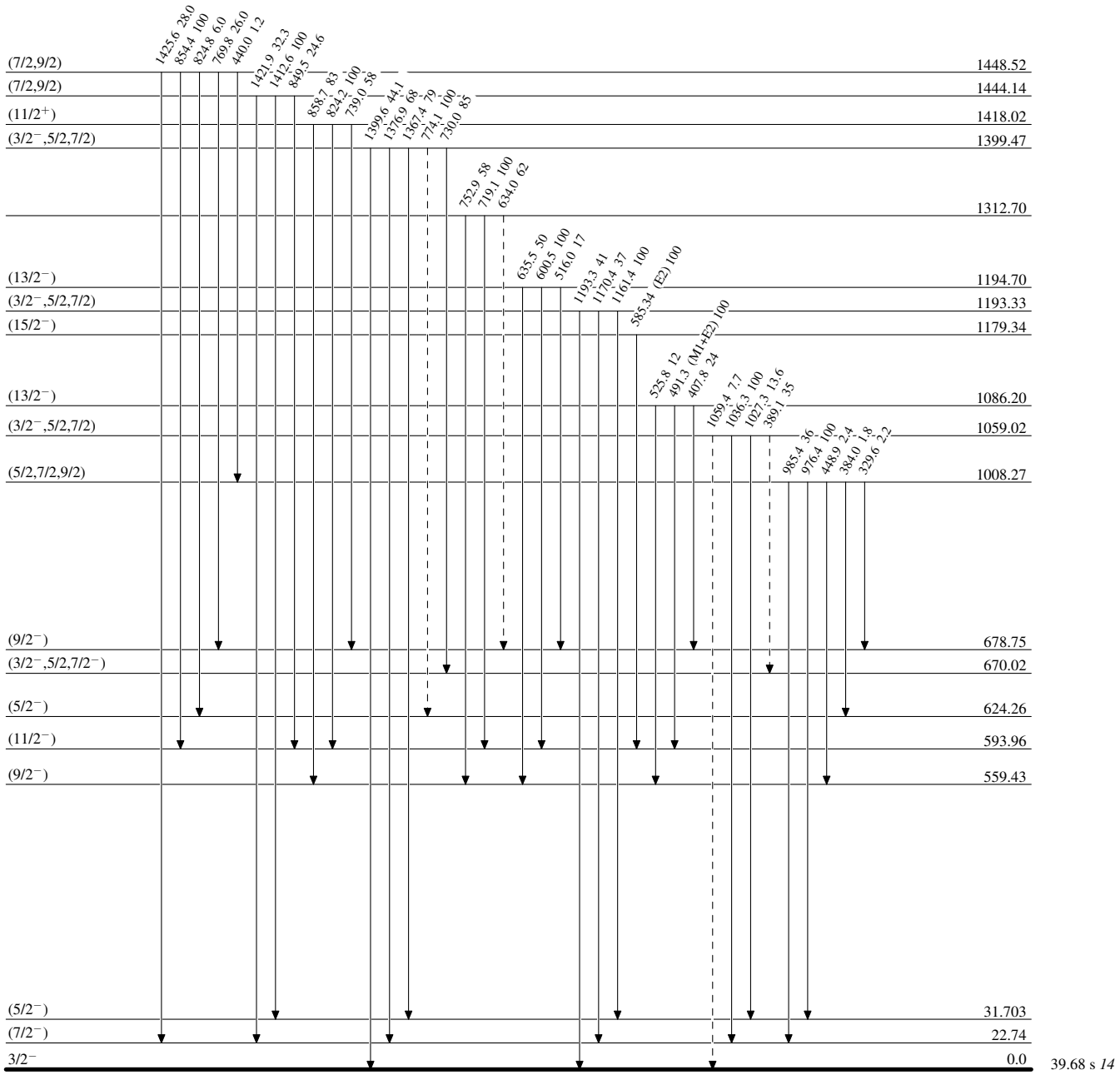
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



$^{139}_{54}Xe_{85}$

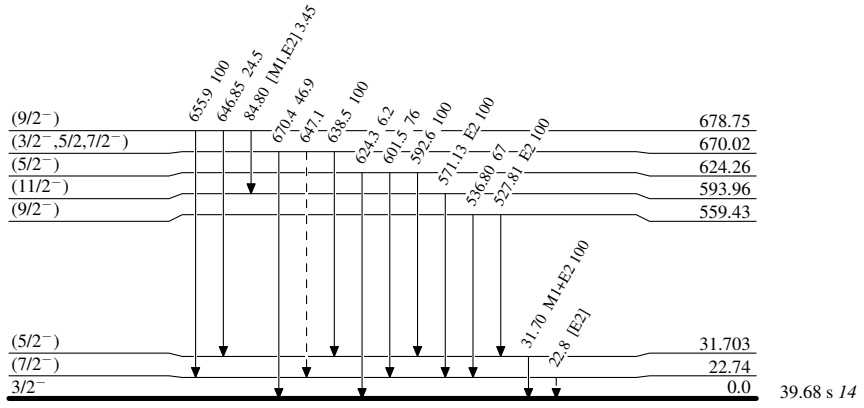
Adopted Levels, Gammas

Legend

Level Scheme (continued)

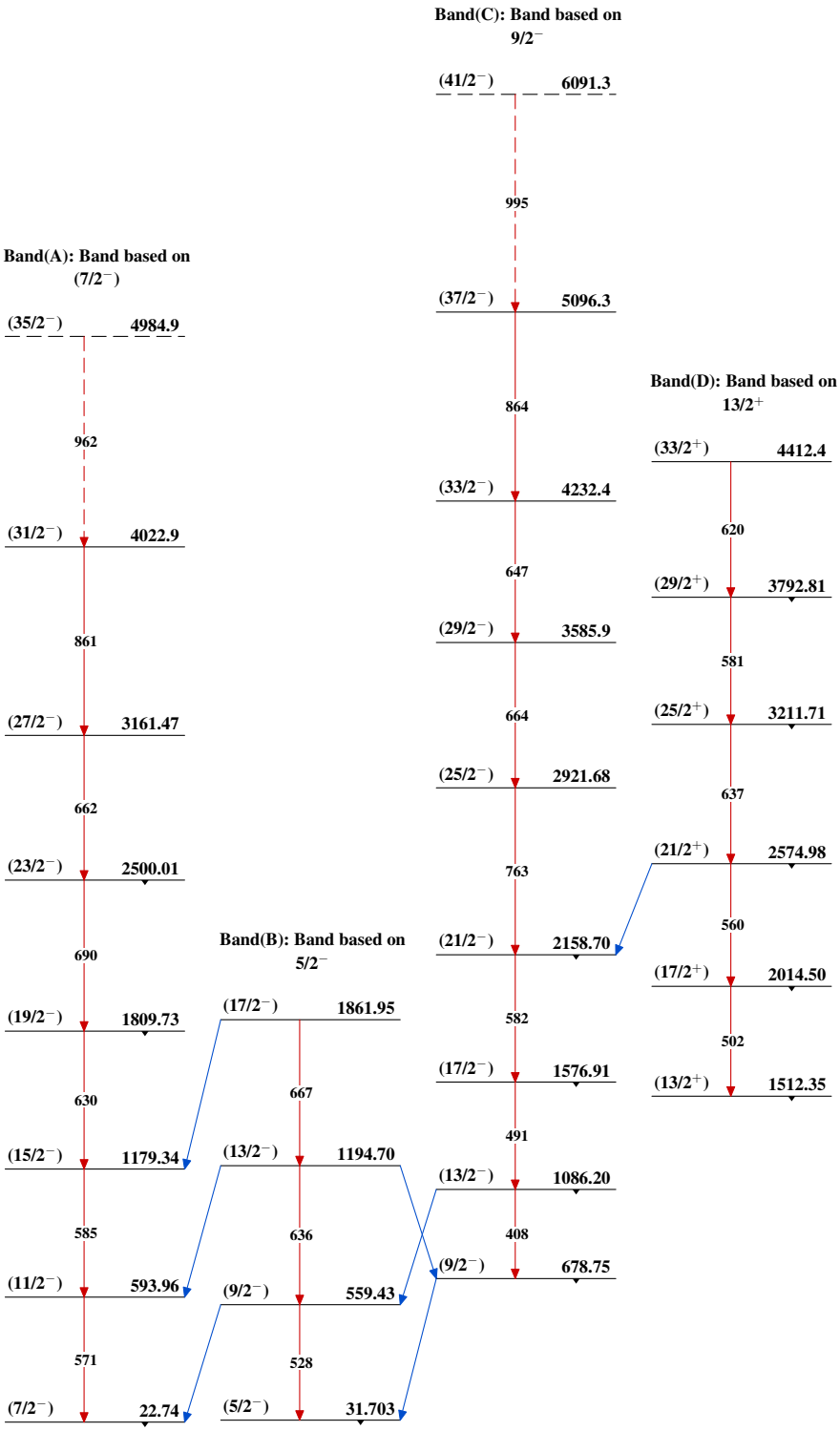
Intensities: Relative photon branching from each level

γ Decay (Uncertain)



$^{139}_{54}Xe_{85}$

Adopted Levels, Gammas



$^{139}_{54}Xe_{85}$