Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh, Alexander A. Rodionov And Yuri L. Khazov	NDS 109, 517 (2008)	1-Jul-2022

Q(β^-)=−8.71×10^3 *SY*; S(n)=9.55×10^3 *SY*; S(p)=3.38×10^3 *16*; Q(α)=2.49×10^3 *16* 2021Wa16

The isotope was first identified by measurement of the x-ray in coincidence with positrons (1977Bo02). On-line mass separation and x-ray coincidences were used by 1989Vi04 in ^{92}Mo(^{46}Ti,2pn) reaction.

^{135}Eu was identified by 1989Vi04 with $T_{1/2}$=1.5 s *2* but no excited in ^{135}Sm from ^{135}Eu ε decay were identified.

A 77-keV γ-ray peak from the decay of ^{135}Sm shows (1989Vi04) a second (unassigned) component with $T_{1/2}$=2.4 s *9* which may correspond to an isomer in ^{135}Sm, but the origin of this component remains unclear.

Nuclear structure calculations: 1992Zh10 (identical bands analyzed), 1992Se09 (magnetic moment, particle-rotor model).

^{135}Sm Levels

Cross Reference (XREF) Flags

A ^{64}Zn(^{74}Se,2pnγ),
B ^{135}Eu ε decay (1.5 s)

E(level)[†]	J$^\pi$[#]	$T_{1/2}$[‡]	XREF	Comments
0.0	(3/2$^+$,5/2$^+$)	10.3 s *5*		%ε+%β^+=100; %εp=0.02 *1* (1989Vi04) J$^\pi$: comparison of the delayed-proton spectrum with the statistical model calculations (1977Bo02) suggests 7/2$^+$. Analysis of εp data by 1989Vi04 favors J=3/2,5/2; 1989Vi04 propose two isomers in ^{135}Sm with J^π=9/2$^-$, 11/2$^-$ for lower energy isomer and J^π=3/2$^+$,5/2$^+$ for higher energy isomer. In high-spin studies low-lying states of J=(3/2$^+$) and (7/2$^+$) are proposed, but the absolute energies are unknown. There seems no evidence for the existence of a long-lived 9/2$^-$ or 11/2$^-$ isomer in ^{135}Sm in high-spin studies, a low lying 9/2$^-$ level is suggested with $T_{1/2}$=7 ns − 35 ns. $T_{1/2}$: from timing of delayed protons, γ- and x-rays (1989Vi04). Other: 10 s *2* (1977Bo02).
0.0+x[d]	(3/2$^+$)		A	Additional information 1. E(level): this level may be the g.s., in which case x=0.
0.0+y[@]	(7/2$^+$)		A	Additional information 2.
≈100+y[c]	(9/2$^-$)	21 ns *14*	A	Additional information 3. $T_{1/2}$: 7 ns − 35 ns (1996MuZZ). E(level): ≈100 keV (1996MuZZ).
207.20+x[d] *20*	(7/2$^+$)		A	
221.35+y[&] *16*	(9/2$^+$)		A	
276.76+y[b] *19*	(11/2$^-$)		A	
458.86+y[@] *16*	(11/2$^+$)		A	
539.8+x[d] *3*	(11/2$^+$)		A	
551.71+y[c] *23*	(13/2$^-$)		A	
691.93+y[&] *21*	(13/2$^+$)		A	
765.38+y[b] *24*	(15/2$^-$)		A	
920.42+y[@] *24*	(15/2$^+$)		A	
1000.8+x[d] *4*	(15/2$^+$)		A	
1133.0+y[c] *3*	(17/2$^-$)		A	
1162.5+y[&] *3*	(17/2$^+$)		A	
1366.2+y[b] *3*	(19/2$^-$)		A	
1423.2+y[@] *3*	(19/2$^+$)		A	

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Adopted Levels, Gammas (continued)

^{135}Sm Levels (continued)

E(level)[†]	Jπ[#]	$T_{1/2}$[‡]	XREF	Comments
1578.4+x[d] 4	(19/2+)		A	
1704.4+y[&] 3	(21/2+)		A	
1788.7+y[c] 3	(21/2−)		A	
2007.4+y[@] 3	(23/2+)		A	
2059.5+y[b] 4	(23/2−)		A	
2253.6+x[d] 5	(23/2+)		A	
2302.8+y[&] 4	(25/2+)		A	
2468.1+y[c] 5	(25/2−)		A	
2677.6+y[@] 4	(27/2+)		A	
2789.3+y[b] 6	(27/2−)		A	
2816.1+y[a] 4	(29/2+)		A	
2935.1+y[&] 4	(29/2+)		A	
3007.7+x?[d] 6	(27/2+)		A	
3131+y[e]	(31/2−)		A	E(level): this level may be the initial level of a different sequence, not connected with..+y levels, if 315γ is placed elsewhere.
3203.1+y?[c] 11	(29/2−)		A	
3431.7+y[@] 5	(31/2+)		A	
3434.30+y[e] 20	(35/2−)		A	
3434.7+y[a] 4	(33/2+)		A	
3606.3+y?[b] 12	(31/2−)		A	
3883.2+y[e] 3	(39/2−)		A	
4121.6+y[a] 5	(37/2+)	0.96 ps	A	
4267.5+y?[@] 6	(35/2+)		A	
4453.7+y[e] 4	(43/2−)		A	
4894.3+y[a] 5	(41/2+)	0.44 ps	A	
5115.3+y[e] 4	(47/2−)		A	
5181.5+y?[@] 12	(39/2+)		A	
5752.0+y[a] 6	(45/2+)	0.207 ps	A	
5820.7+y[e] 5	(51/2−)		A	
6487.6+y?[e] 6	(55/2−)		A	
6693.3+y[a] 6	(49/2+)	0.152 ps	A	
7715.3+y[a] 7	(53/2+)	0.083 ps	A	
8817.1+y[a] 7	(57/2+)	0.064 ps	A	
9998.0+y[a] 9	(61/2+)	0.037 ps	A	
11260.0+y[a] 13	(65/2+)		A	
12599.0+y[a] 17	(69/2+)		A	

† From least-squares fit to Eγ′s. Normalized χ^2=3.1 is larger than critical χ^2=1.9. There are four γ rays that fit poorly, just outside 2σ′s.
‡ From DSA (1992Re05) for excited states.
\# For excited states, all assignments are based on: 1. *3/2*$^+$ for 0+x and 7/2$^+$ for 0+y states; 2. γγ(θ)(DCO) data for higher excitations; 3. band associations; and 4. cranked-shell model calculations.
@ Band(A): ν7/2[404], α=−1/2. From orbital $g_{7/2}$. VMI analysis: parameter Δ=100 keV, 120 keV for both signature partners treated as one band.
& Band(B): ν7/2[404], α=+1/2. From orbital $g_{7/2}$. VMI analysis: parameter Δ=16 keV, 120 keV for both signature partners treated as one band.

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Adopted Levels, Gammas (continued)

^{135}Sm Levels (continued)

[a] Band(C): SD band, ν1/2[606]. From orbital $i_{13/2}$, α=+1/2. Q(intrinsic)=7.0 *7* (from DSA,1992Re05), 5.8 *4* or 6.4 *4* (2002La09, 2001Ri20). The values correspond to β_2≈0.37, indicating SD shape. VMI analysis: parameter Δ=18 keV.
[b] Band(D): ν9/2[514], α=−1/2. From orbital $h_{11/2}$, band assignment by 1996MuZZ. VMI analysis: parameter Δ=10 keV, 42 keV for both signature partners treated as one band.
[c] Band(E): ν9/2[514], α=+1/2. From orbital $h_{11/2}$, band assignment by 1996MuZZ. VMI analysis: parameter Δ=23 keV, 42 keV for both signature partners treated as one band.
[d] Band(F): ΔJ=2 band. Tentative band from 1989MuZR with configuration=$\nu s_{1/2}$ or $\nu d_{3/2}$ VMI analysis: parameter Δ=5 keV.
[e] Band(G): ΔJ=2 band. Tentative band from 1989MuZR with configuration=$\nu f_{7/2}$ VMI analysis: parameter Δ=65 keV.

γ(^{135}Sm)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[†]	α[&]	Comments
≈100+y	(9/2$^-$)	≈100	100	0.0+y	(7/2$^+$)	[E1]	0.276	B(E1)(W.u.)≈0.000010 α(K)≈0.232; α(L)≈0.0341; α(M)≈0.00730; α(N+..)≈0.00187 α(N)≈0.001627; α(O)≈0.000230; α(P)≈1.125×10^{-5}
207.20+x	(7/2$^+$)	207.2 *2*	100	0.0+x	(3/2$^+$)	Q[‡]		
221.35+y	(9/2$^+$)	221.0 *2*	100	0.0+y	(7/2$^+$)	D[#]		
276.76+y	(11/2$^-$)	176.8 *2*	100	≈100+y	(9/2$^-$)	D[#]		
458.86+y	(11/2$^+$)	237.6 *2*	50 *8*	221.35+y	(9/2$^+$)	D[#]		
		459.2 *2*	≈100	0.0+y	(7/2$^+$)	Q[‡]		
539.8+x	(11/2$^+$)	332.6 *2*	100	207.20+x	(7/2$^+$)	Q[‡]		
551.71+y	(13/2$^-$)	274.9 *2*	100 *13*	276.76+y	(11/2$^-$)	D[#]		
		451.6 *5*	34 *14*	≈100+y	(9/2$^-$)			
691.93+y	(13/2$^+$)	233.4 *2*	35 *5*	458.86+y	(11/2$^+$)	D[#]		
		469.6 *3*	≈100	221.35+y	(9/2$^+$)	Q[‡]		E_γ: level-energy difference=470.6.
765.38+y	(15/2$^-$)	213.5 *2*	54 *6*	551.71+y	(13/2$^-$)	D[#]		
		488.7 *2*	100 *8*	276.76+y	(11/2$^-$)	Q[‡]		
920.42+y	(15/2$^+$)	228.1 *2*	42 *6*	691.93+y	(13/2$^+$)	D[#]		
		461.8 *3*	≈100	458.86+y	(11/2$^+$)	Q[‡]		
1000.8+x	(15/2$^+$)	461.0 *2*	100	539.8+x	(11/2$^+$)	Q[‡]		
1133.0+y	(17/2$^-$)	367.8 *3*	35 *5*	765.38+y	(15/2$^-$)	D[#]		
		581.4 *2*	100 *10*	551.71+y	(13/2$^-$)	Q[‡]		
1162.5+y	(17/2$^+$)	241.8 *2*	36 *5*	920.42+y	(15/2$^+$)	D[#]		
		471.2 *3*	≈100	691.93+y	(13/2$^+$)	Q[‡]		E_γ: level-energy difference=470.6.
1366.2+y	(19/2$^-$)	232.8 *3*	20 *5*	1133.0+y	(17/2$^-$)	D[#]		
		600.6 *2*	100 *9*	765.38+y	(15/2$^-$)	Q[‡]		
1423.2+y	(19/2$^+$)	260.7 *2*	28 *7*	1162.5+y	(17/2$^+$)	D[#]		
		502.8 *2*	100 *9*	920.42+y	(15/2$^+$)	Q[‡]		
1578.4+x	(19/2$^+$)	577.6 *2*	100	1000.8+x	(15/2$^+$)	Q[‡]		
1704.4+y	(21/2$^+$)	281.2 *2*	20 *3*	1423.2+y	(19/2$^+$)	D[#]		
		541.9 *2*	100 *7*	1162.5+y	(17/2$^+$)	Q[‡]		
1788.7+y	(21/2$^-$)	422.6 *3*	67 *11*	1366.2+y	(19/2$^-$)	D[#]		
		656.0 *2*	100 *17*	1133.0+y	(17/2$^-$)	Q[‡]		
2007.4+y	(23/2$^+$)	303.1 *2*	20 *6*	1704.4+y	(21/2$^+$)	D[#]		
		584.1 *2*	100 *10*	1423.2+y	(19/2$^+$)	Q[‡]		

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Adopted Levels, Gammas (continued)

$\gamma(^{135}Sm)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[†]	α[&]	Comments
2059.5+y	(23/2⁻)	271.7 *3*	25 *4*	1788.7+y	(21/2⁻)	D[#]		E_γ: level-energy difference=270.9.
		692.6 *3*	100 *7*	1366.2+y	(19/2⁻)	Q[‡]		E_γ: level-energy difference=693.4.
2253.6+x	(23/2⁺)	675.2 *2*	100	1578.4+x	(19/2⁺)	Q[‡]		
2302.8+y	(25/2⁺)	295.0 *5*	7 *4*	2007.4+y	(23/2⁺)	D[#]		
		598.5 *2*	100 *8*	1704.4+y	(21/2⁺)	Q[‡]		
2468.1+y	(25/2⁻)	408.7 *4*	75 *14*	2059.5+y	(23/2⁻)			
		679.3 *4*	100 *14*	1788.7+y	(21/2⁻)	Q[‡]		
2677.6+y	(27/2⁺)	670.2 *2*	100	2007.4+y	(23/2⁺)	Q[‡]		
2789.3+y	(27/2⁻)	320.7[a] *5*	22 *4*	2468.1+y	(25/2⁻)			
		729.8 *4*	100 *9*	2059.5+y	(23/2⁻)	Q[‡]		
2816.1+y	(29/2⁺)	513.3 *2*	100	2302.8+y	(25/2⁺)	Q[‡]		
2935.1+y	(29/2⁺)	632.2 *2*	100	2302.8+y	(25/2⁺)	Q[‡]		
3007.7+x?	(27/2⁺)	754.1[a] *3*		2253.6+x	(23/2⁺)			
3131+y	(31/2⁻)	315[a]		2816.1+y	(29/2⁺)			
3203.1+y?	(29/2⁻)	735[a] *1*	100	2468.1+y	(25/2⁻)			
3431.7+y	(31/2⁺)	754.1 *3*	100	2677.6+y	(27/2⁺)	Q[‡]		
3434.30+y	(35/2⁻)	303.3 *2*	100	3131+y	(31/2⁻)	Q[‡]		
3434.7+y	(33/2⁺)	499.6 *2*	79 *7*	2935.1+y	(29/2⁺)	Q[‡]		
		618.7 *2*	100 *9*	2816.1+y	(29/2⁺)	Q[‡]		
3606.3+y?	(31/2⁻)	817[a] *1*	100	2789.3+y	(27/2⁻)			
3883.2+y	(39/2⁻)	448.9 *2*	100	3434.30+y	(35/2⁻)	Q[‡]		
4121.6+y	(37/2⁺)	686.9 *2*	100	3434.7+y	(33/2⁺)	E2[@]	0.00576	B(E2)(W.u.)=93 α(K)=0.00482 *7*; α(L)=0.000740 *11*; α(M)=0.0001603 *23*; α(N+..)=4.16×10⁻⁵ *6* α(N)=3.61×10⁻⁵ *5*; α(O)=5.27×10⁻⁶ *8*; α(P)=2.83×10⁻⁷ *4*
4267.5+y?	(35/2⁺)	835.8[a] *3*	100	3431.7+y	(31/2⁺)			
4453.7+y	(43/2⁻)	570.5 *2*	100	3883.2+y	(39/2⁻)	Q[‡]		
4894.3+y	(41/2⁺)	772.7 *2*	100	4121.6+y	(37/2⁺)	E2[@]	0.00438	B(E2)(W.u.)=113 α(K)=0.00368 *6*; α(L)=0.000548 *8*; α(M)=0.0001183 *17*; α(N+..)=3.08×10⁻⁵ *5* α(N)=2.67×10⁻⁵ *4*; α(O)=3.91×10⁻⁶ *6*; α(P)=2.17×10⁻⁷ *3*
5115.3+y	(47/2⁻)	661.6 *2*	100	4453.7+y	(43/2⁻)	Q[‡]		
5181.5+y?	(39/2⁺)	914.0[a] *10*	100	4267.5+y?	(35/2⁺)			
5752.0+y	(45/2⁺)	857.7 *2*	100	4894.3+y	(41/2⁺)	E2[@]	0.00346	B(E2)(W.u.)=143 α(K)=0.00292 *4*; α(L)=0.000425 *6*; α(M)=9.15×10⁻⁵ *13*; α(N+..)=2.39×10⁻⁵ *4* α(N)=2.06×10⁻⁵ *3*; α(O)=3.04×10⁻⁶ *5*; α(P)=1.732×10⁻⁷ *25*
5820.7+y	(51/2⁻)	705.4 *2*	100	5115.3+y	(47/2⁻)	Q[‡]		
6487.6+y?	(55/2⁻)	666.9[a] *3*	100	5820.7+y	(51/2⁻)	Q[‡]		
6693.3+y	(49/2⁺)	941.3 *2*	100	5752.0+y	(45/2⁺)	E2[@]	0.00283	B(E2)(W.u.)=122

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Adopted Levels, Gammas (continued)

$\gamma(^{135}Sm)$ (continued)

E_i(level)	J_i^π	E_γ†	I_γ†	E_f	J_f^π	Mult.†	α&	Comments
								α(K)=0.00239 *4*; α(L)=0.000341 *5*; α(M)=7.34×10^{-5} *11*; α(N+..)=1.92×10^{-5} *3* α(N)=1.657×10^{-5} *24*; α(O)=2.45×10^{-6} *4*; α(P)=1.421×10^{-7} *20*
7715.3+y	(53/2$^+$)	1022.0 *3*	100	6693.3+y	(49/2$^+$)	E2@	0.00237	B(E2)(W.u.)=148 α(K)=0.00202 *3*; α(L)=0.000283 *4*; α(M)=6.07×10^{-5} *9*; α(N+..)=1.588×10^{-5} *23* α(N)=1.372×10^{-5} *20*; α(O)=2.03×10^{-6} *3*; α(P)=1.198×10^{-7} *17*
8817.1+y	(57/2$^+$)	1101.8 *3*	100	7715.3+y	(53/2$^+$)	[E2]	0.00203	B(E2)(W.u.)=132 α(K)=0.001727 *25*; α(L)=0.000240 *4*; α(M)=5.13×10^{-5} *8*; α(N+..)=1.377×10^{-5} *20* α(N)=1.161×10^{-5} *17*; α(O)=1.724×10^{-6} *25*; α(P)=1.028×10^{-7} *15*; α(IPF)=3.40×10^{-7} *7*
9998.0+y	(61/2$^+$)	1180.9 *4*	100	8817.1+y	(57/2$^+$)	[E2]	1.77×10^{-3}	B(E2)(W.u.)=162 α(K)=0.001502 *21*; α(L)=0.000206 *3*; α(M)=4.41×10^{-5} *7*; α(N+..)=1.540×10^{-5} *22* α(N)=9.98×10^{-6} *14*; α(O)=1.486×10^{-6} *21*; α(P)=8.94×10^{-8} *13*; α(IPF)=3.84×10^{-6} *7*
11260.0+y	(65/2$^+$)	1262		9998.0+y	(61/2$^+$)			
12599.0+y	(69/2$^+$)	1339		11260.0+y	(65/2$^+$)			

† From ^{64}Zn(^{74}Se,2pnγ),^{92}Mo(^{46}Ti,2pnγ).

‡ R(DCO) indicates ΔJ=2, quadrupole (most likely E2).

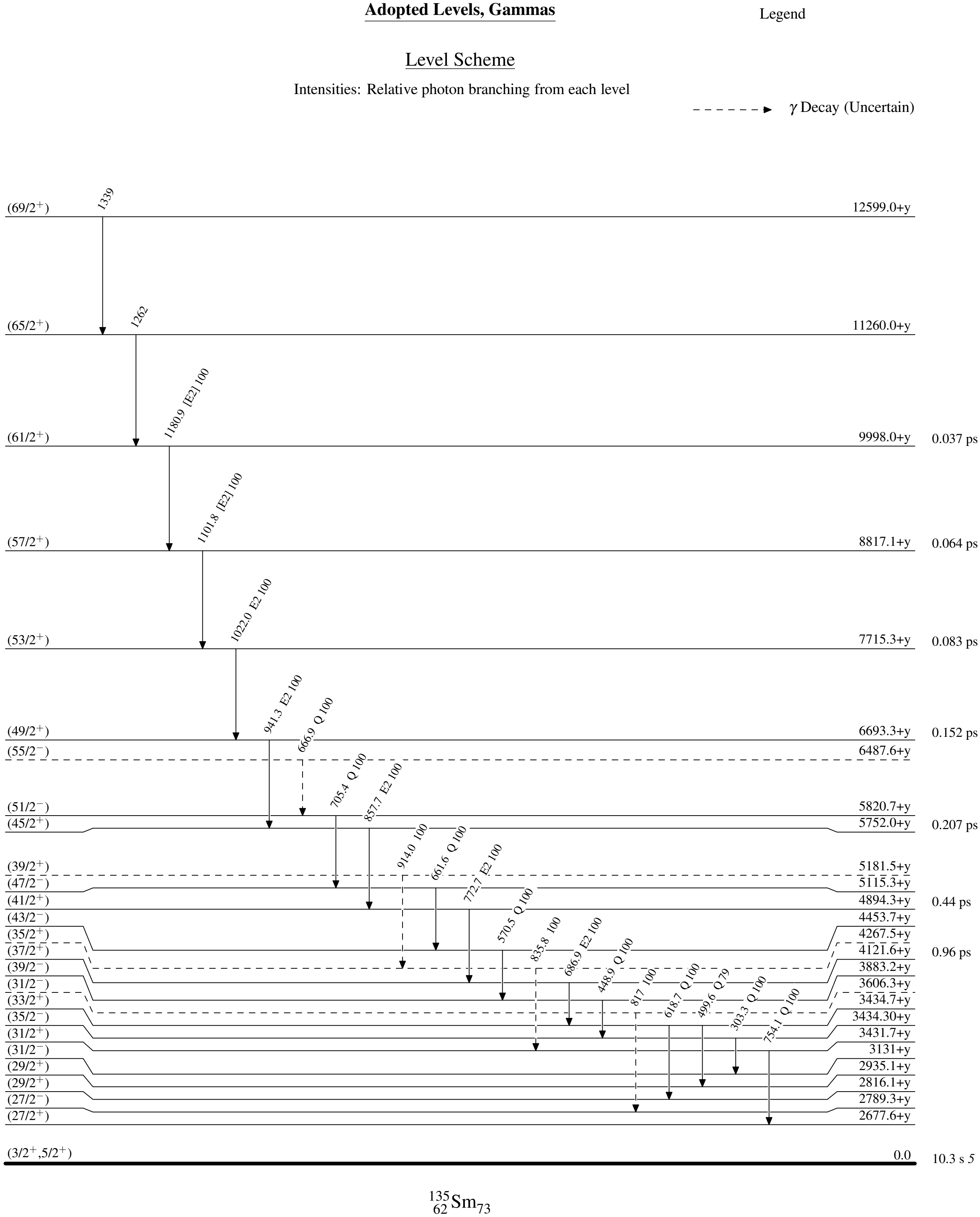
\# R(DCO) indicates ΔJ=1, dipole or dipole+quadrupole.

@ From R(DCO) (indicating ΔJ=2) and RUL(for E2 and M2).

& 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.

^{a} Placement of transition in the level scheme is uncertain.

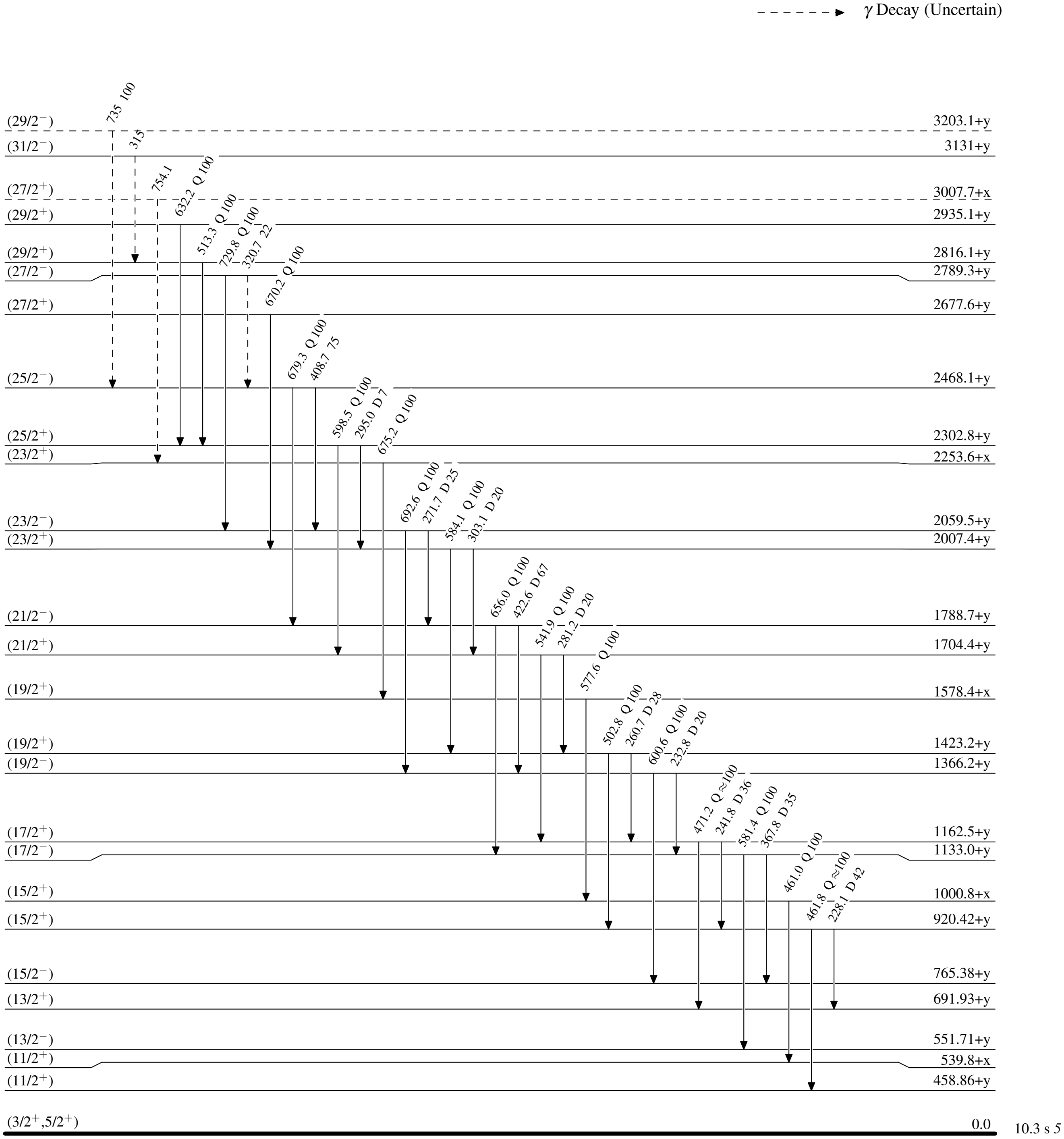
Adopted Levels, Gammas



Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level

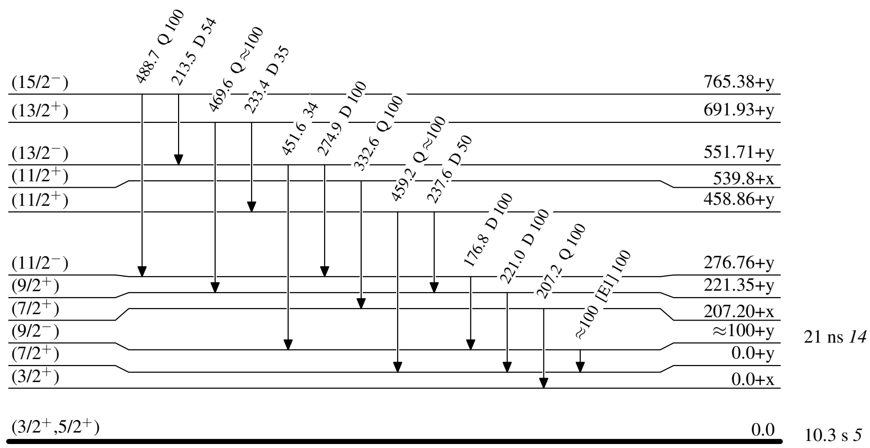


$^{135}_{62}Sm_{73}$

Adopted Levels, Gammas

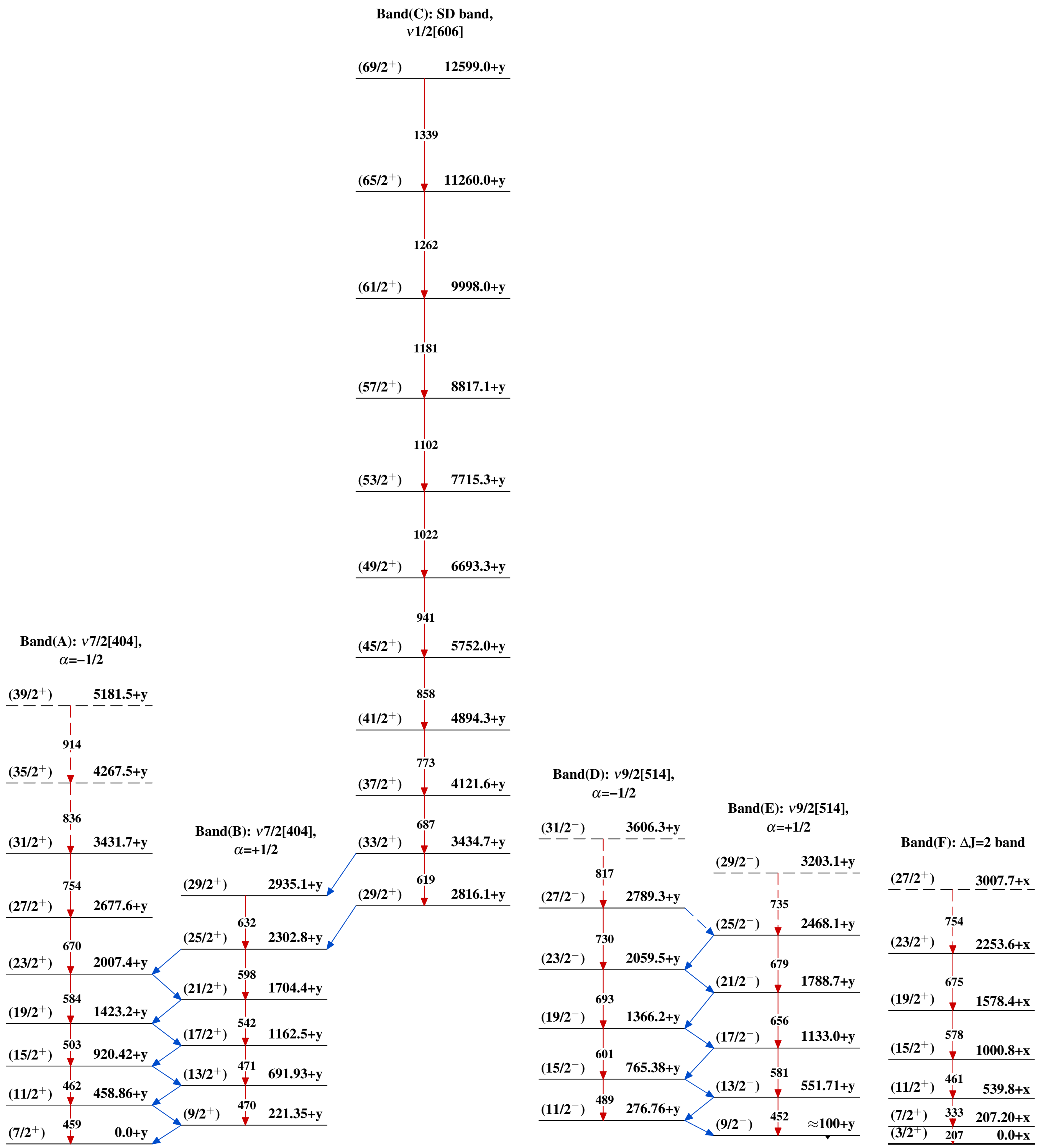
Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{135}_{62}Sm_{73}$

Adopted Levels, Gammas



$^{135}_{62}Sm_{73}$

Adopted Levels, Gammas (continued)