^{96}Zr(α,2nγ) 2016Th01,1971Le19

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen, Balraj Singh	NDS 164, 1 (2020)	15-Feb-2020

Includes ^{96}Zr(^{9}Be,X) from 2003ReZY.

2016Th01 (also 2013Th09): E(α)=16 MeV. Measured Eγ, Iγ, γγ, γγ(θ), lifetimes by Doppler line-shape analysis using YRAST Ball array of ten Compton-suppressed HPGe Clover detectors at WNSL-Yale accelerator facility. Target=1.25 mg/cm^2 thick 57.36% enriched ^{96}Zr. Deduced levels, J^π, branching ratios, mixing ratios, B(M1), B(E2), configuration mixing, shape coexistence and mixed-symmetry states. Comparison with theoretical calculations using proton-neutron Interacting Boson Model (IBM-2) based on Skyrme energy density functional. Partial results of this work were reported in 2013Th09 up to 2420 level.

1971Le19: E(α)=30 MeV from the Berkeley 88-inch cyclotron. Target was 5-20 mg/cm^2 powdered oxide of ^{96}Zr. γ rays were detected with planar Ge(Li) detectors. Measured Eγ, Iγ, γγ-coin, γ(θ). Deduced levels, J, π.

2003ReZY (also analysis in 2003Re10): ^{96}Zr(^{9}Be,X),E=44 MeV. Measured Eγ, Iγ, γγ-coin using YRASTBALL at WNSL Tandem accelerator facility at Yale. Analyzed Eγ over spin (E-GOS) plots.

^{98}Mo Levels

Level scheme is based on γγ-coin data in 2016Th01.

A tentative 4779, (12$^+$) level decaying by a tentative 629γ in 2003ReZY is omitted here, as it is not reported in a later high-spin study by 2007La03.

E(level)[†]	J^π[&]	$T_{1/2}$	Comments
0.0	0^+		
734.75 *4*	0^+	21.8[a] ns *9*	Additional information 1.
787.30[@] *11*	2^+	3.47[a] ps *7*	
1432.20 *12*	2^+	1.53[a] ps *16*	
1509.99[@] *13*	4^+	2.53[a] ps *5*	
1758.39 *12*	2^+	1.42[a] ps *6*	
1962.86 *20*	0^+		
2017.54 *13*	3^-	65[a] ps *7*	
2037.31 *22*	$0^{(+)}$		
2104.77 *15*	3^+		
2206.79 *25*	2^+	<0.257[b] ps	Candidate for one-phonon mixed symmetry state. $T_{1/2}$: effective $T_{1/2}$=0.208 ps *49* from 1419.48γ.
2223.78 *15*	4^+		
2333.06 *24*	2^+	<0.47[b] ps	This level is defined separately from the 2333.41 level based on γγ-coin evidence for the 900.85-keV transition, and Doppler shift shown by this γ ray, and not by the other γ rays from 2333.41,4$^+$ level. J^π: from (901γ)(1432γ)(θ) as shown in Fig. A.7 of 2016Th01; J=3 and 4 are not supported by these data. $T_{1/2}$: effective $T_{1/2}$=0.35 ps *12* from 900.85γ.
2333.41 *16*	4^+		J^π: from (1546γ)(787γ)(θ) as shown in Fig. A.8 of 2016Th01; J=2 and 3 are not supported by these data.
2343.54[@] *16*	6^+	5.2[a] ps *2*	
2418.6 *3*	$2^{(+)}$		
2419.63 *17*	4^+		J^π: from (661γ)(1023γ)(θ) (Fig. A.5 in 2016Th01); J^π=3$^-$ from a previous (p,t) experiment disagrees with the present results.
2485.38 *18*	3^+		
2506.31 *16*	5^+		J^π: from (996γ)(722γ)(θ) (Fig. A.6 in 2016Th01); rejecting the previously proposed assignments of (3) or (3$^-$,4$^+$).
2525.5 *3*	$2^{(+)}$	<0.367[b] ps	J^π: 2016Th01 assign J=2, referring to 2003Si07 evaluation, but there this level is assigned (1$^-$,2$^+$). Parity is from Table 6 in 2016Th01. $T_{1/2}$: effective $T_{1/2}$=0.326 ps *41* from 1093.32γ.

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^{96}Zr(α,2nγ) 2016Th01,1971Le19 (continued)

^{98}Mo Levels (continued)

E(level)[†]	Jπ[&]	$T_{1/2}$	Comments
2562.53 *23*	2		
2570.8[‡] *6*			
2572.97 *18*	3		
2574.45 *18*	4^+		
2612.3 *5*	$0^{(+)}$		
2620.1 *3*	3^+		
2620.77[@] *16*	5^-		
2678.74 *17*	6^+		Jπ: (4^+) in 1971Le19.
2700.9 *4*	2^+[a]	<0.208[b] ps	Candidate for mixed symmetry state. Jπ: $\gamma\gamma(\theta)$ (2016Th01) favors J=2, but J=1 and 3 are not completely ruled out. $T_{1/2}$: effective $T_{1/2}$=0.173 ps *35* from 1913.60γ.
2733.3 *4*	2^+[a]		Jπ: $\gamma\gamma(\theta)$ (2016Th01) gives J=2 or 3.
2737.9[‡] *6*			
2768.5 *4*	4^+		
2795.60 *18*	4^-		
2812.8 *4*	$1^+,2^+,3^+$		Jπ: from $\gamma\gamma(\theta)$ (2016Th01); (2^+) is favored by previous (p,p′) and (d,d′) data.
2836.59 *19*	6^+		Jπ: (4^+) in 1971Le19.
2853.99[@] *23*	$8^+,7^+,6^+$		Jπ: (6,7,8) in 1971Le19; 8^+ in 2003ReZY.
2871.1[#] *5*	2,3	<0.35[b] ps	Jπ: from $\gamma\gamma(\theta)$ (2016Th01).
2896.76[#] *20*	5^+		
2905.1 *8*	4^+[a]	<0.166[b] ps	$T_{1/2}$: effective $T_{1/2}$=0.152 ps *14* from 2117.81γ.
2916.4 *5*	(2^+)	<0.138[b] ps	$T_{1/2}$: effective $T_{1/2}$=0.076 ps *+62−42* from 2129.03γ.
2962.7 *3*	(2^+,3,4^+)		
2977.0 *3*	4^+	<0.67[b] ps	$T_{1/2}$: effective $T_{1/2}$=0.44 ps *23* from 1466.96γ.
3020.24 *19*	5^-		
3021.6 *4*	(4^+)		Jπ: 2016Th01 assigned Jπ=(5^-), referring to 2003Si07 evaluation, but there this level is assigned (4^+). Also (5^-) requires unlikely mult=E3 for four transitions from this level to 2^+ levels, thus evaluators assign (4^+).
3026.2[#] *3*	5^+		
3050.5 *6*	4^+[a]	<0.146[b] ps	$T_{1/2}$: effective $T_{1/2}$=0.125 ps *21* from 1540.47γ.
3067.55 *23*	4^-,5		
3095.98[@] *18*	7^-		
3109.18 *21*	2^+,4		
3210.6 *4*	(4^+)[a]		
3229.00 *25*	$5^+,6^{(+)}$	<0.173[b] ps	Jπ: 2016Th01 assign $5^+,6,7^+,8^+$, however, 1718.80γ to 4^+ seems to exist from previous β decay results, which makes Jπ=$6^-,7^+$ and 8^+ unlikely, thus the evaluators assign $5^+,6^{(+)}$. $T_{1/2}$: effective $T_{1/2}$=0.152 ps *21* from 885.5γ.
3271.50[@] *23*	(8^+)		Jπ: $8^+,7^+,6^+$ in 2016Th01, (8^+) in 1971Le19 from $\gamma(\theta)$ and in 2003ReZY.
3323.38[#] *22*	$7^{(-)}$		
3557.0[#] *5*		<0.215[b] ps	$T_{1/2}$: effective $T_{1/2}$=0.166 ps *49* from 1213.41γ.
3656.6[‡@] *4*	(7,8,9^-)		Jπ: 9^- in 2003ReZY.
3768.6[‡] *6*	(7,8,9^-)		
4149.6[‡@] *6*	(8,9,10^+)		Jπ: 10^+ in 2003ReZY.
4423.8[‡@] *7*			Jπ: 11^- in 2003ReZY.
4440.4?[‡] *8*			
4537.7[‡] *8*			
4609.8?[‡] *9*			

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^{96}Zr(α,2nγ) 2016Th01,1971Le19 (continued)

^{98}Mo Levels (continued)

† Deduced from least-squares fit to Eγ values, omitting all the γ rays listed by 2016Th01 from 2003Si07 evaluation, and not reported as observed by them in their Table 2. Energy of the 734.75 level was kept as fixed. Reduced χ^2=0.84.
‡ Level from 1971Le19 only.
# Newly proposed level in 2016Th01.
@ Level also reported in 2003ReZY.
& As proposed by 2016Th01 based on $\gamma\gamma(\theta)$ data and previous assignments in literature, unless otherwise noted.
a From Adopted Levels.
b Measured effective half-life (not corrected for side feeding) from Doppler line-shape analysis (2016Th01) for the most intense γ ray from a level.

^{96}Zr(α,2nγ) 2016Th01,1971Le19 (continued)

γ(^{98}Mo)

No delayed γ rays ($T_{1/2}$>3 ns) were observed in 1971Le19.

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[&]	δ[&]	α[a]	Comments
787.30	2+	52.6[‡]		734.75	0+	[E2]		12.08	α(K)=8.33 *12*; α(L)=3.10 *5*; α(M)=0.569 *8* α(N)=0.0772 *11*; α(O)=0.001082 *16*
		787.26 *15*	100	0.0	0+	E2			A_2=+0.16 *3*; A_4=−0.09 *6* (1971Le19) α(K)=0.001203 *17*; α(L)=0.0001385 *20*; α(M)=2.47×10^{-5} *4* α(N)=3.74×10^{-6} *6*; α(O)=2.05×10^{-7} *3* Mult.: also from $\gamma(\theta)$ in 1971Le19. Eγ=787.6 *2*, Iγ=100 (1971Le19).
1432.20	2+	644.70 *15*	100	787.30	2+	M1+E2	+1.67 *25*	0.00226	Eγ=644.6 *5*, Iγ=1.6 *5* (1971Le19). δ: 2016Th01 discussed their result with previous measurements and conclude that a larger mixing ratio (dominant E2 component) is favored by the analysis of their (645γ)(787γ)(θ) data (Fig. A.4 in 2016Th01), as well as δ(E2/M1)=+3.2 *+46−14* deduced from OSIRIS data. Low values of +0.13 *4*, +0.27 *2* and 0.58 *5* reported in previous experiments are inconsistent with the $\gamma\gamma(\theta)$ data in the present experiment, while a value of +1.70 *16* reported in a previous (n,n′γ) experiment is in agreement with the present result.
		697.10 *46*	5.8 *7*	734.75	0+	[E2]		0.00187	
		1432.29 *20*	81.5 *16*	0.0	0+	E2			
1509.99	4+	78.0[‡]		1432.20	2+	[E2]		2.95	α(K)=2.30 *4*; α(L)=0.545 *8*; α(M)=0.0993 *14* α(N)=0.01377 *20*; α(O)=0.000316 *5* Additional information 2.
		722.48 *15*	100	787.30	2+	E2		0.00171	A_2=+0.18 *5*; A_4=−0.09 *7* (1971Le19) Mult.: also from $\gamma(\theta)$ (1971Le19). δ(M3/E2)=+0.02 *3* (2016Th01). Eγ=722.8 *2*, Iγ=85 *4* (1971Le19).
1758.39	2+	248.5[‡]		1509.99	4+				
		326.05 *25*	7.0 *3*	1432.20	2+	(M1(+E2))	−0.17 *22*	0.0112 *8*	
		971.03 *16*	65.9 *10*	787.30	2+	M1+E2	−0.97 *14*		
		1023.61 *16*	100	734.75	0+	E2			
		1758.64[‡] *14*		0.0	0+				
1962.86	0+	530.61 *30*	39.1 *29*	1432.20	2+	[E2]		0.00398	
		1175.57 *20*	100	787.30	2+	E2			
2017.54	3−	258.96 *26*	22.0 *19*	1758.39	2+	(E1)		0.00823	Eγ=259.0 *5*, Iγ=1.26 *20* (1971Le19). δ(M2/E1)=+0.01 *6* (2016Th01).
		507.8[‡] *2*		1509.99	4+				
		1230.04 *15*	100	787.30	2+	(E1)			δ(M2/E1)=−0.04 *7* (2016Th01). Eγ=1229.7 *5*, Iγ=6.9 *8* (1971Le19).

$^{98}_{42}Mo_{56}$-4

γ(^{98}Mo) (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[&]	δ[&]	α[a]	Comments
2017.54	3⁻	2018.01 *53*	16.2 *17*	0.0	0⁺	[E3]			
2037.31	0$^{(+)}$	1250.00 *19*	100	787.30	2⁺	(E2)			
2104.77	3⁺	594.65[‡] *12*		1509.99	4⁺				
		672.50 *17*	78.9 *28*	1432.20	2⁺	M1+E2	+6.7 *+34−17*	0.00206	
		1317.37 *17*	100	787.30	2⁺	M1+E2	+2.9 *+6−5*		
2206.79	2⁺	448.2[‡] *2*		1758.39	2⁺				
		1419.48 *22*	100	787.30	2⁺	M1+E2	−0.33 *11*		
2223.78	4⁺	206.3[‡] *5*		2017.54	3⁻				
		465.5[‡] *2*		1758.39	2⁺				
		713.80 *16*	100	1509.99	4⁺	M1+E2	+1.13 *17*	0.00173	
		791.58 *17*	82.9 *36*	1432.20	2⁺	(E2)		0.00135	δ(M3/E2)=+0.07 *8* (2016Th01).
		1436.68 *25*	23.4 *19*	787.30	2⁺	(E2)			δ(M3/E2)=−0.03 *7* (2016Th01).
2333.06	2⁺	900.85 *21*	100	1432.20	2⁺	(M1(+E2))	−0.15 *+19−20*		
2333.41	4⁺	109.48 *44*	10.9 *44*	2223.78	4⁺				
		575.06[‡] *10*		1758.39	2⁺				
		823.33 *16*	77.4 *47*	1509.99	4⁺	M1+E2	−0.388 *7*	0.00123	
		1546.30 *22*	100	787.30	2⁺	(E2)			δ(M3/E2)=−0.04 *4* (2016Th01).
2343.54	6⁺	833.52 *15*	100	1509.99	4⁺	E2		0.00119	A_2=+0.20 *4*; A_4=−0.10 *6* (1971Le19) δ(M3/E2)=−0.01 *7* (2016Th01). Mult.: also from γ(θ) in 1971Le19. Eγ=833.7 *2*, Iγ=57 *2* (1971Le19).
2418.6	2$^{(+)}$	986.34 *27*	100	1432.20	2⁺	(M1(+E2))	+0.01 *7*		
		1631.26 *50*	96.5 *59*	787.30	2⁺				
2419.63	4⁺	195.66[‡] *10*		2223.78	4⁺				
		314.9[‡] *2*		2104.77	3⁺				
		402.33 *39*	10.0 *14*	2017.54	3⁻	[E1]		0.00254	
		661.16 *40*	17.8 *13*	1758.39	2⁺	(E2)		0.00215	δ(M3/E2)=+0.09 *10* (2016Th01).
		909.52 *17*	100	1509.99	4⁺	M1+E2	−0.64 *10*		δ: from (909γ)(722γ)(θ) shown in Fig. A.5 of 2016Th01.
		987.48[‡] *10*		1432.20	2⁺				
		1632.46 *33*	40.5 *16*	787.30	2⁺	[E2]			
2485.38	3⁺	151.9[‡] *2*		2333.41	4⁺				
		380.05 *43*	21.8 *17*	2104.77	3⁺				
		467.0[‡] *9*		2017.54	3⁻				
		726.83[‡] *10*	<4.6	1758.39	2⁺				I_γ: 2016Th01 did not observe this γ in coincidence with the 1023γ as expected from previously reported data. Upper limit of intensity is given by 2016Th01.
		975.25 *32*	35.9 *17*	1509.99	4⁺	M1+E2	−0.9 *+6−16*		δ(E2/M1)=−0.89 *+62−160* (2016Th01).
		1053.04 *26*	55.2 *27*	1432.20	2⁺	M1+E2	−0.97 *+27−36*		
		1698.49 *26*	100	787.30	2⁺	M1+E2	−0.52 *13*		
2506.31	5⁺	86.51 *32*	8.2 *44*	2419.63	4⁺				

$^{98}_{42}$Mo$_{56}$-5

γ(^{98}Mo) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[&]	δ[&]	α[a]	Comments
2506.31	5^+	162.53[‡] *15*		2343.54	6^+				
		172.89 *16*	73.6 *32*	2333.41	4^+	(M1(+E2))	+0.05 *11*	0.057 *3*	α(K)=0.0496 *22*; α(L)=0.0058 *4*; α(M)=0.00104 *7* α(N)=0.000158 *9*; α(O)=8.8×10^{-6} *4* Eγ=173.2 *5*, Iγ=1.63 *16* (1971Le19), unplaced γ.
		282.52[‡] *10*		2223.78	4^+				
		299.6[‡b] *2*		2206.79	2^+	[M3]		0.244	α(K)=0.207 *3*; α(L)=0.0309 *5*; α(M)=0.00566 *8* α(N)=0.000847 *12*; α(O)=4.20×10^{-5} *6* Mult=M3 implied by ΔJ^π makes this transition very unlikely, thus its placement is marked as questionable.
		996.33 *16*	100	1509.99	4^+	M1+E2	−0.96 *10*		δ: from (996γ)(722γ)(θ) (Fig. A.6 in 2016Th01).
2525.5	$2^{(+)}$	1093.32 *26*	100	1432.20	2^+	(M1(+E2))	+0.01 *17*		
2562.53	2	544.52 *39*	7.4 *9*	2017.54	3^-				
		803.6[‡] *5*		1758.39	2^+				
		1775.37 *23*	100	787.30	2^+	D(+Q)	+0.05 *7*		
2570.8		227.3[b] *5*		2343.54	6^+				Iγ=1.27 *14* (1971Le19).
2572.97	3	239.2[‡] *2*		2333.41	4^+				
		555.07 *35*	47.0 *66*	2017.54	3^-				
		814.46 *26*	49.6 *27*	1758.39	2^+	D(+Q)	+0.10 *10*		
		1140.83 *47*	29.1 *34*	1432.20	2^+				
		1785.90 *24*	100	787.30	2^+	D(+Q)	+0.01 *6*		
2574.45	4^+	350.81 *18*	100	2223.78	4^+	(M1(+E2))	−0.13 *24*	0.0092 *6*	
		557.08 *39*	19.9 *56*	2017.54	3^-	[E1]		0.00115	
		1064.27 *18*	90.9 *40*	1509.99	4^+	M1+E2	−2.7 *+8−15*		δ(E2/M1)=−2.69 *+75−147* (2016Th01).
2612.3	$0^{(+)}$	1824.95 *44*	100	787.30	2^+	(E2)			
2620.1	3^+	1187.50 *43*	9.7 *7*	1432.20	2^+	M1+E2	+0.95 *+98−50*	5.48×10^{-4} *12*	
		1832.93 *33*	100	787.30	2^+	M1+E2	−0.54 *13*		
		1886.3[‡b] *7*		734.75	0^+	[M3]			Mult=M3 implied by ΔJ^π makes this transition very unlikely, thus its placement is marked as questionable.
2620.77	5^-	603.25 *17*	63.3 *12*	2017.54	3^-	(E2)		0.00277	δ(M3/E2)=−0.08 *11* (2016Th01). Eγ=603.5 *5*, Iγ=5.2 *5* (1971Le19).
		1110.75 *16*	100	1509.99	4^+	(E1)			A_2=−0.18 *10*; A_4=0.00 *15* (1971Le19) δ(M2/E1)=−0.05 *10* (2016Th01). Eγ=1110.4 *2*, Iγ=10.9 *7* (1971Le19).
2678.74	6^+	172.47 *26*	3.6 *5*	2506.31	5^+				
		335.15 *16*	52.8 *8*	2343.54	6^+	(M1(+E2))	−0.01 *10*	0.01022 *17*	Eγ=335.1 *5*, Iγ=1.57 *20* (1971Le19).
		345.53[‡] *10*		2333.41	4^+				E_γ: 345.258 *20* listed in Table 1 of 2016Th01 is erroneous.
		455.04[‡] *10*		2223.78	4^+				

$^{98}_{42}$Mo$_{56}$-6

^{96}Zr(α,2nγ) 2016Th01,1971Le19 (continued)

γ(^{98}Mo) (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[&]	δ[&]	α[a]	Comments
2678.74	6^+	1168.81 *16*	100	1509.99	4^+	(E2)			δ(M3/E2)=+0.01 *4* (2016Th01). Eγ=1168.2 *5*, Iγ=3.6 *6* (1971Le19).
2700.9	2^+	493.4[‡] *6*		2206.79	2^+				
		1913.60 *33*	100	787.30	2^+	(M1(+E2))	−0.14 *14*		
2733.3	2^+	1946.01 *33*	100	787.30	2^+	(M1(+E2))	−0.09 *15*		δ: for J(2733.3 level)=2. Other: +0.27 *10* for J=3.
2737.9		394.4[b] *5*		2343.54	6^+				Iγ=4.3 *3* (1971Le19).
2768.5	4^+	1981.20 *32*	100	787.30	2^+	(E2)			δ(M3/E2)=+0.01 *11* (2016Th01).
2795.60	4^-	778.01[#] *20*	37.7 *31*	2017.54	3^-	M1+E2	−0.37 *15*	0.0014	
		1285.63 *16*	100	1509.99	4^+	(E1)			δ(M2/E1)=−0.02 *3* (2016Th01).
2812.8	$1^+,2^+,3^+$	2025.46[#] *39*	100	787.30	2^+	M1+E2	−4 *+2−57*		δ: δ(E2/M1)=−4.4 *+22−567* for J(2813 level)=2.
2836.59	6^+	157.87 *16*	100	2678.74	6^+				Eγ=157.8 *5*, Iγ=1.15 *12* (1971Le19).
		330.18 *23*	23.3 *56*	2506.31	5^+	M1+E2	−0.24 *6*	0.01098 *25*	
		493.09 *20*	23.0 *56*	2343.54	6^+	M1+E2	−0.29 *15*	0.00407 *10*	
		1326.7[‡]		1509.99	4^+				
2853.99	$8^+,7^+,6^+$	282.2[@] *5*		2570.8					Iγ=0.5 *3* (1971Le19).
		510.45 *16*	100	2343.54	6^+				Eγ=510.5 *5*, Iγ=14 *2* (1971Le19).
2871.1	2,3	2083.74[#] *40*	100	787.30	2^+	D+Q			δ: δ(Q/D)=+0.06 *10* for J(2871 level)=3, −3.7 *+15−58* for J=2.
2896.76	5^+	791.83[#] *28*	100	2104.77	3^+	[E2]		0.00135	
		1386.84[#] *19*	96.0 *35*	1509.99	4^+	M1+E2	+3.2 *+8−5*		α(K)=0.000338 *5*; α(L)=3.77×10^{-5} *6*; α(M)=6.72×10^{-6} *10* α(N)=1.023×10^{-6} *15*; α(O)=5.82×10^{-8} *9*; α(IPF)=4.65×10^{-5} *7*
2905.1	4^+	2117.81[#] *72*	100	787.30	2^+				
2916.4	(2^+)	2129.03 *45*	100	787.30	2^+	(M1+E2)	−0.71 *+37−57*		
2962.7	$(2^+,3,4^+)$	944.39 *44*	18.5 *47*	2017.54	3^-				
		1452.69 *42*	100	1509.99	4^+				
		2176.41[#] *47*	83 *14*	787.30	2^+				
2977.0	4^+	557.1[‡] *4*		2419.63	4^+				
		753.19[‡] *14*		2223.78	4^+				
		1466.96 *24*	100	1509.99	4^+	(M1(+E2))	+0.05 *17*		
		2189.4[‡] *5*		787.30	2^+				
3020.24	5^-	399.43 *18*	100	2620.77	5^-	(M1(+E2))	+0.06 *15*	0.00664 *15*	
		676.66 *26*	33.5 *24*	2343.54	6^+	(E1)			δ(M2/E1)=−0.01 *10* (2016Th01).
		1002.85 *31*	24.4 *10*	2017.54	3^-	(E2)			δ(M3/E2)=+0.03 *5* (2016Th01).
		1510.4[‡]		1509.99	4^+				
3021.6	(4^+)	688.23[‡] *10*		2333.41	4^+				2016Th01 placed this transition feeding the 2333.02

γ(^{98}Mo) (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[&]	δ[&]	α[a]	Comments
									level, however, the least-squares fit procedure (using GTOL code) reproduces the level energies of the 2333 doublet in 2016Th01 better if this γ were to feed the 2333.41 level, thus the evaluators place this γ from the 3021.83 level to 2333.41 level.
3021.6	(4$^+$)	797.88[‡] *10*		2223.78	4$^+$				
		815.5[‡] *3*		2206.79	2$^+$				
		917.05[‡] *13*		2104.77	3$^+$				
		1004.31[‡] *10*		2017.54	3$^-$				
		1263.36[‡] *11*		1758.39	2$^+$				
		1511.65 *34*	100	1509.99	4$^+$				
		1589.62[‡] *10*		1432.20	2$^+$				
		2234.31[‡] *10*		787.30	2$^+$				
3026.2	5$^+$	1516.19[#] *25*	100	1509.99	4$^+$	M1+E2	+0.27 *6*		
3050.5	4$^+$	544.5[‡] *4*		2506.31	5$^+$				
		631.4[‡] *2*		2419.63	4$^+$				
		717.5[‡] *3*		2333.06	2$^+$				
		1540.47 *52*	100	1509.99	4$^+$	(M1(+E2))	−0.20 *27*		
		1618.75[‡] *11*		1432.20	2$^+$				
		2263.0[‡] *2*		787.30	2$^+$				
3067.55	4$^-$,5	446.78 *17*	100	2620.77	5$^-$				
3095.98	7$^-$	241.7[@b] *5*		2853.99	8$^+$,7$^+$,6$^+$				Iγ=1.0 *5* (1971Le19).
		475.23 *17*	100	2620.77	5$^-$	(E2)		0.00552	A_2=+0.24 *4*; A_4=−0.12 *20* (1971Le19) δ(M3/E2)=+0.01 *3* (2016Th01). Eγ=475.7 *2*, Iγ=9.3 *5* (1971Le19).
		752.41 *16*	81.2 *16*	2343.54	6$^+$	(E1)			δ(M2/E1)=−0.01 *4* (2016Th01). Eγ=752.8 *5*, Iγ=12 *3* (1971Le19). I_γ: the intensity in the present experiment is consistent with results from a previous (α,2nγ) experiment, but not with the previous β-decay results. 2016Th01 point out that in previous β decay study, if the intensities of the two gamma rays (753.0 and 753.19) near this energy were to be interchanged, then the results agree with the present data.
3109.18	2$^+$,4	1091.52 *20*	100	2017.54	3$^-$				
		1599.50 *33*	24.2 *37*	1509.99	4$^+$				
3210.6	(4$^+$)	1193.09 *30*	100	2017.54	3$^-$				
3229.00	5$^+$,6$^{(+)}$	885.48 *21*	100	2343.54	6$^+$				
		1718.80 *55*	<23.8	1509.99	4$^+$				
3271.50	(8$^+$)	927.95 *17*	100	2343.54	6$^+$	Q			A_2=+0.21 *7*; A_4=−0.18 *11* (1971Le19)

γ(^{98}Mo) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[&]	δ[&]	α[a]	Comments
									Mult.: from γ(θ) in 1971Le19. Eγ=928.1 *2*, Iγ=18 *1* (1971Le19).
3323.38	$7^{(-)}$	227.37[#] *18*	100	3095.98	7^-	(M1(+E2))	−0.08 *10*	0.0276 *10*	α(K)=0.0242 *9*; α(L)=0.00282 *13*; α(M)=0.000505 *22* α(N)=7.7×10^{-5} *4*; α(O)=4.28×10^{-6} *13*
		979.87[#] *23*	99.9 *66*	2343.54	6^+				
3557.0		1213.41[#] *38*	100	2343.54	6^+				
3656.6	$(7,8,9^-)$	385.1[@] *5*		3271.50	(8^+)				Iγ=0.38 *7* (1971Le19).
		560.7[@] *5*		3095.98	7^-				Iγ=0.38 *7* (1971Le19). I_γ: part may be due to ^{97}Mo.
		803		2853.99	$8^+,7^+,6^+$				E_γ: γ from 2003ReZY only.
3768.6	$(7,8,9^-)$	672.6[@] *5*		3095.98	7^-				Iγ=7.8 *5* (1971Le19).
4149.6	$(8,9,10^+)$	878.1[@] *5*		3271.50	(8^+)				Iγ=5.4 *5* (1971Le19).
		1296		2853.99	$8^+,7^+,6^+$				E_γ: γ from 2003ReZY only.
4423.8		767.2[@] *5*		3656.6	$(7,8,9^-)$				Iγ=5.1 *8* (1971Le19).
4440.4?		290.8[@b] *5*		4149.6	$(8,9,10^+)$				Iγ=1.9 *3* (1971Le19).
4537.7		769.1[@] *5*		3768.6	$(7,8,9^-)$				Iγ=4.5 *8* (1971Le19).
4609.8?		169.4[@b] *5*		4440.4?					Iγ=1.57 *16* (1971Le19).

[†] From 2016Th01, unless otherwise indicated. Intensities listed are relative branching ratios from each level. Relative intensities from 1971Le19 at θ=126° are normalized to I(787.3γ)=100 and given under comments. Corresponding Eγ values measured by 1971Le19 are also given under comments, where, based on a general comment in 1971Le19, uncertainties are 0.1-0.2 keV for strong γ rays, and larger (assumed 0.5 keV here) for weak γ rays.

[‡] 2016Th01 listed this γ in their Table 2 from 2003Si07 evaluation. This γ ray was either not observed by 2016Th01 due to detection sensitivity limit in their experiment, or not confirmed. Its energy is not used in the least-squares fitting procedure.

[#] New γ ray reported by 2016Th01.

[@] From 1971Le19 only, probable assignment to ^{98}Mo from γγ data. Uncertainties based on a general comment that these are 0.1-0.2 keV for strong γ rays, and larger (assumed 0.5 keV here) for weak γ rays.

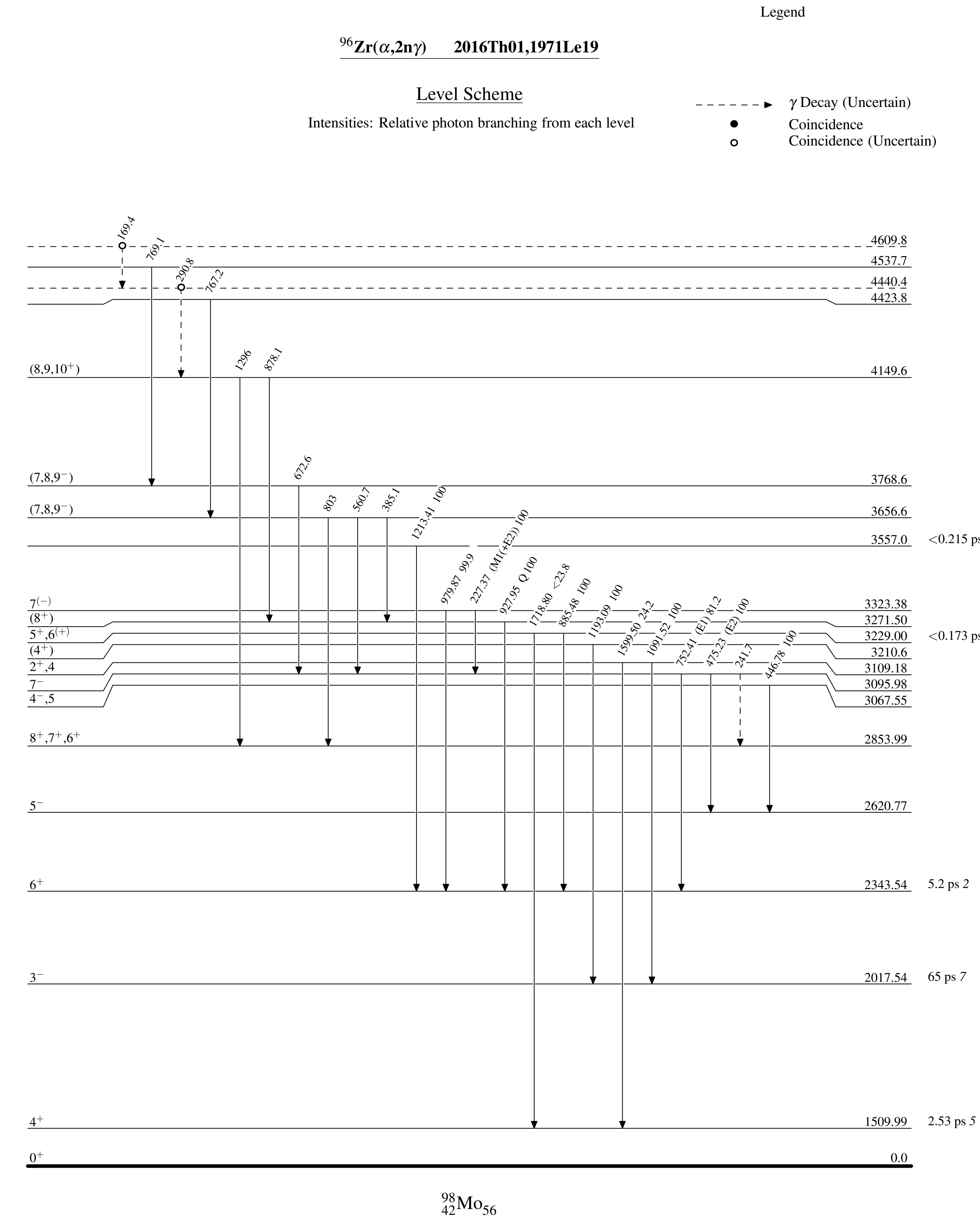
[&] From γγ(θ) in 2016Th01. For levels of known half-lives, RUL used to assign E2 or M1+E2, in contrast to M2 or E1+M2, respectively. For large δ(Q/D) mixing ratios, mult=M1+E2 are assigned, based on RUL, assuming that level half-lives are not longer than few ns. Assumed assignments, from ΔJ^π are listed in square brackets.

[a] 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.

[b] Placement of transition in the level scheme is uncertain.

[x] γ ray not placed in level scheme.

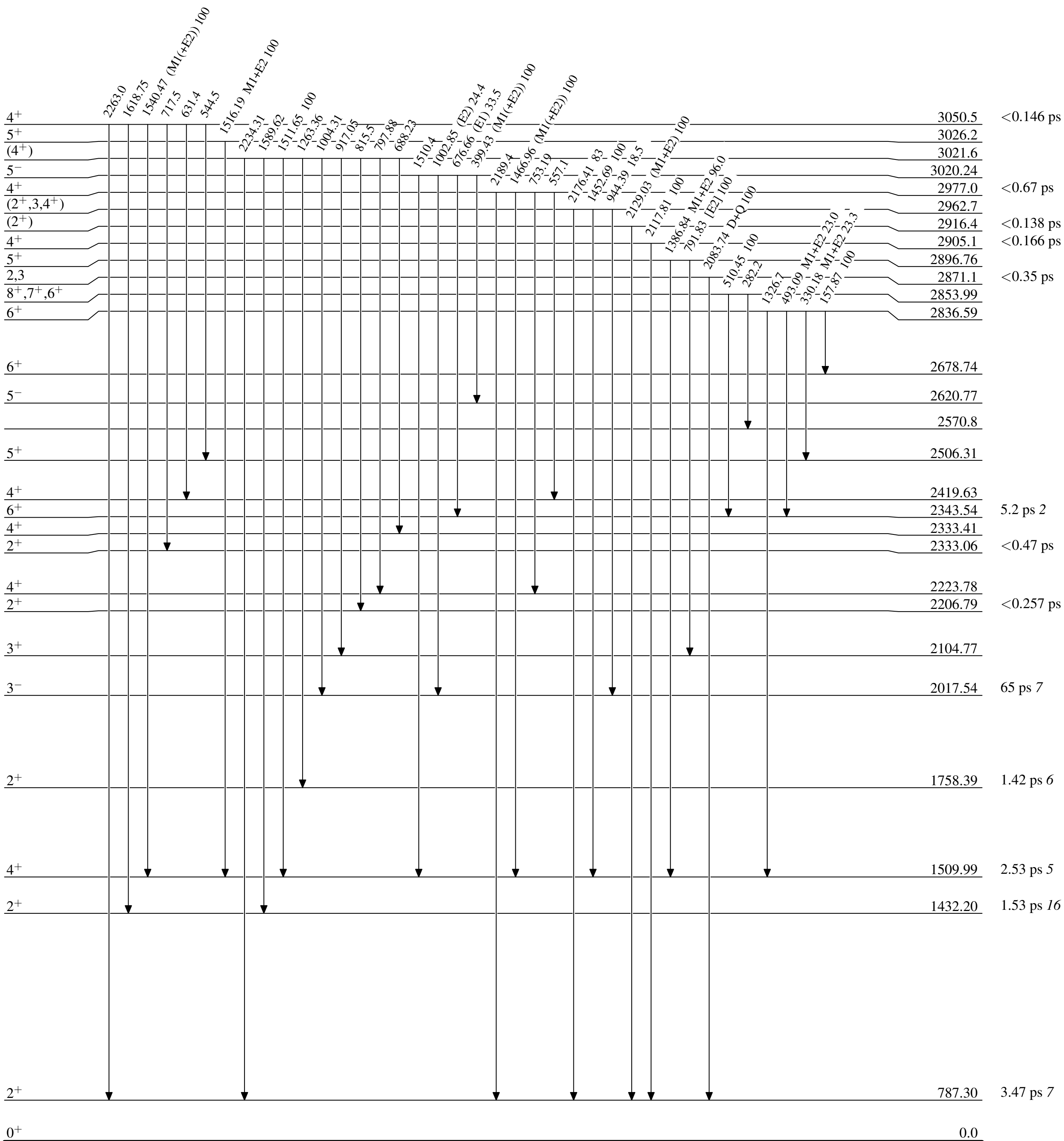
$^{98}_{42}Mo_{56}$-9


Legend
^{96}Zr(α,2nγ) 2016Th01,1971Le19
Level Scheme
Intensities: Relative photon branching from each level
γ Decay (Uncertain)
Coincidence
Coincidence (Uncertain)
4609.8
4537.7
4440.4
4423.8
(8,9,10+) 4149.6
(7,8,9−) 3768.6
(7,8,9−) 3656.6
3557.0 <0.215 ps
7(−) 3323.38
(8+) 3271.50
5+,6(+) 3229.00 <0.173 ps
(4+) 3210.6
2+,4 3109.18
7− 3095.98
4−,5 3067.55
8+,7+,6+ 2853.99
5− 2620.77
6+ 2343.54 5.2 ps 2
3− 2017.54 65 ps 7
4+ 1509.99 2.53 ps 5
0+ 0.0
169.4
769.1
290.8
767.2
1296
878.1
672.6
803
560.7
385.1
1213.41 100
979.87 99.9
227.37 (M1(+E2)) 100
927.95 Q 100
1718.80 <23.8
885.48 100
1193.09 100
1599.50 24.2
1091.52 100
752.41 (E1) 81.2
475.23 (E2) 100
241.7
446.78 100
$^{98}_{42}$Mo$_{56}$

^{96}Zr(α,2nγ) 2016Th01,1971Le19

Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{98}_{42}Mo_{56}$

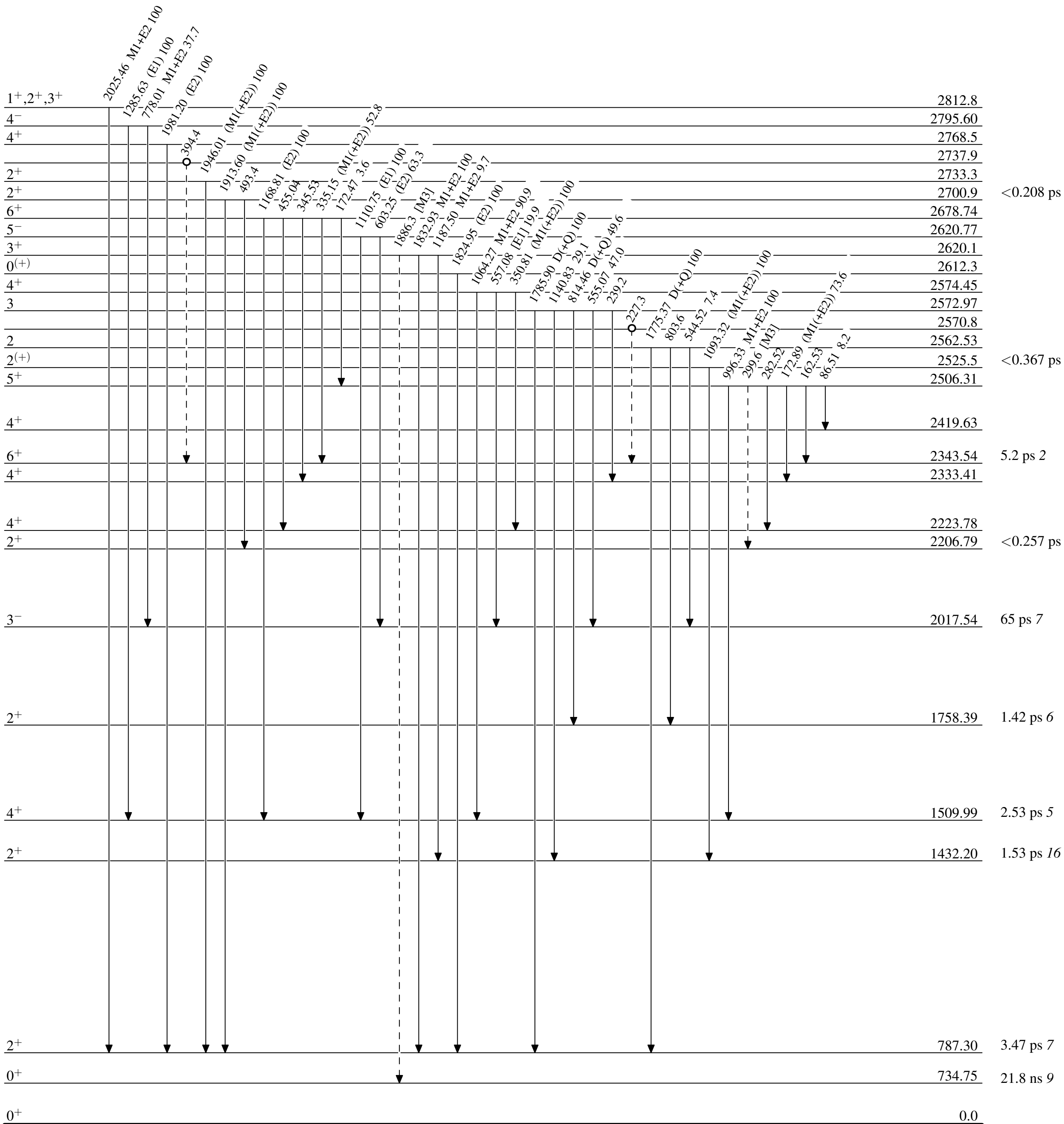
Legend

^{96}Zr(α,2nγ) 2016Th01,1971Le19

Level Scheme (continued)

Intensities: Relative photon branching from each level

γ Decay (Uncertain)
● Coincidence
○ Coincidence (Uncertain)

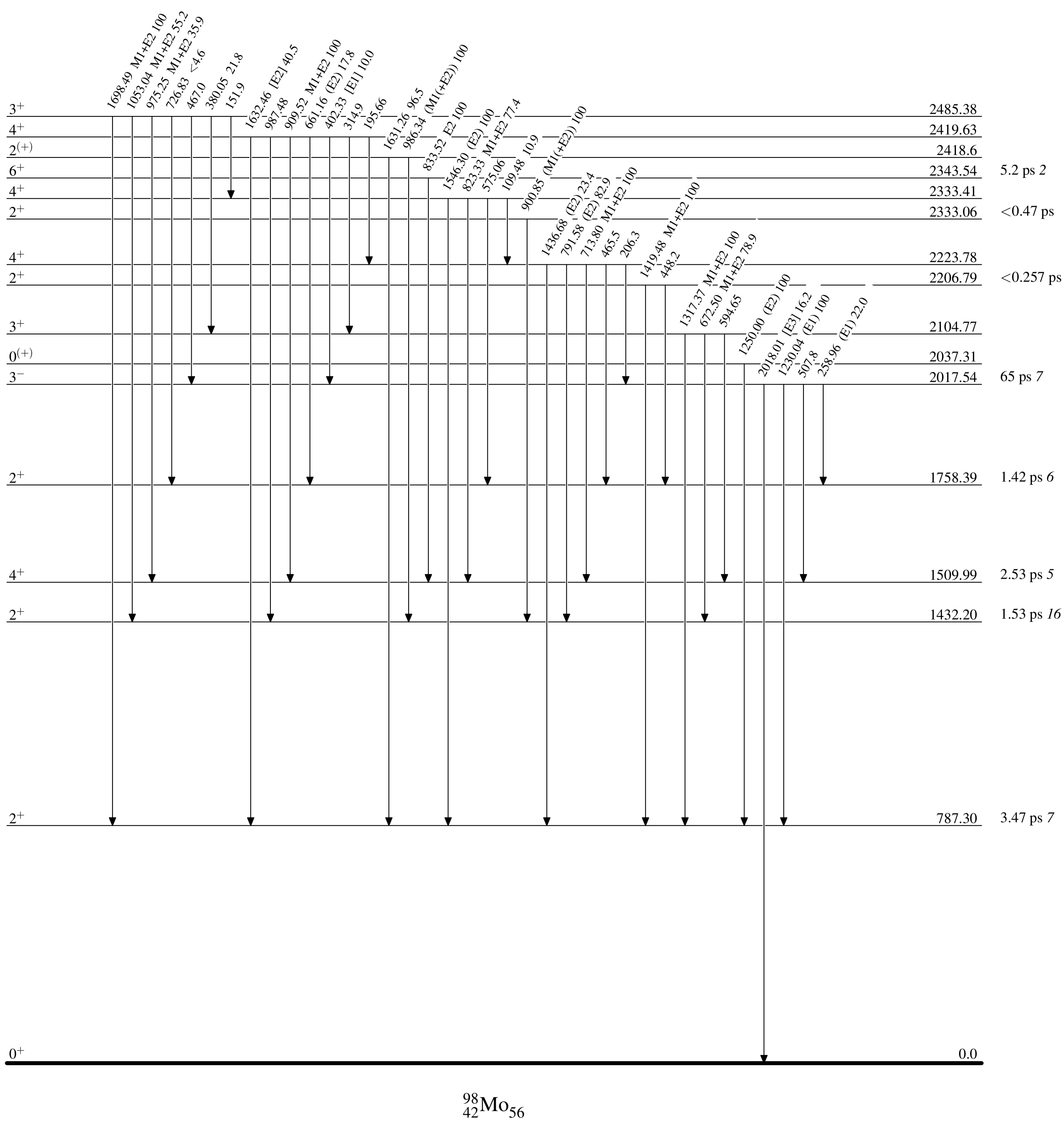


$^{98}_{42}Mo_{56}$

^{96}Zr(α,2nγ) 2016Th01,1971Le19

Level Scheme (continued)

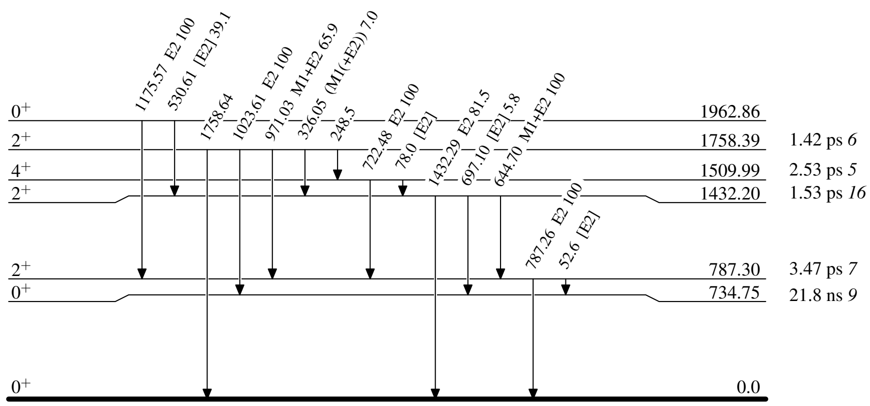
Intensities: Relative photon branching from each level



^{96}Zr(α,2nγ) 2016Th01,1971Le19

Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{98}_{42}Mo_{56}$