^{45}Sc(p,p′γ)

History			
Type	Author	Citation	Literature Cutoff Date
Full Evaluation	T. W. Burrows	NDS 109, 171 (2008)	30-Oct-2007

1968Ch25: E=2.5, 3.2, and 3.6 MeV. Measured γ′s and γγ-coincidences (Ge(Li),NaI).
1970Bl02: E=1.8 to 4.5 MeV. Measured γ′s, γγ-coincidences (NaI,Ge(Li)), pγ-coincidences (Si), and ce′s (spect).
1970Ea02: E=3.0 and 3.45 MeV. Measured γ(θ) and γγ(θ) and ce′s (spect,Si(Li)).
1974Ru02: E=5.0 MeV. Measured γ′s and pγ-coincidences (Si,Ge(Li)). DSAM.
1975Da16: E=2, 2.5, 3, 3.5 MeV. Measured protons (Si); γ′s and excit.
1980Bu08: E=5.5 MeV. Measured γ′s and pγ-coincidences (Si,Ge(Li)). DSAM, RDM. See also (p,p′),(d,d′) and Coulomb excitation.
1983Ra17: E=3, 4.5 MeV. Measured γ′s. DSAM.
1985Av04: E=3.5-5.0 MeV. Measured γ′s and γ(θ). DSAM.
Others: see 1992Bu01, Coulomb excitation (1979Pa12 and 1986Ta14) and 1983Bu21.

^{45}Sc Levels

E_x	T	TV Adopted $T_{1/2}$ (ps)	Average of the following DSAM measurements, except as noted: 1974Ru02 (ps)	1980Bu08 (ps)	1983Ra17 (ps) Ep=3 MeV	Ep=4.5 MeV	1985Av04 (ps)
543		5.3 *10*			4.5 *10*		6.9 *+23−16*
	TVWeighted						
720		0.193 *22*	0.152 *42*	0.152 *42*	0.200 *+36−23*		0.228 *+23−16*
	TVUnweighted. 1974Ru02						
	TV89and 1980Bu08 assumed						
	TV89to be the same.						
975		2.49 *35*			2.08 *+47−34*		3.16 *+78−47*
	TVWeighted						
1068		0.45 *16*		0.76 *35*	0.22 *+7−5*		0.38 *+14−9*
	TVUnweighted						
1237		1.60 *34*	0.76 *14*	2.4 *19*	1.46 *+31−24*		1.81 *+27−20*
	TVUnweighted						
1409		0.257 *+23−18*		0.250 *49*	0.270 *+47−35*		0.254 *+31−24*
	TVWeighted						
1662		0.095 *7*	0.076 *21*	0.080 *11*	0.100 *+20−15*		0.103 *8*
	TVWeighted						
2138		0.31 *+9−7*					
	0.40 *+17−12*			0.50 *+18−12*	TVWeighted		
2290		0.21 *7*		0.17 *4*			0.250 *25*
	TVUnweighted						
				0.51 *17*			
2342		0.026 *11*		0.015 *10*		0.036 *2*	TVUnweighted

E(G) Adopted	TV	Weighted average of the following data (held fixed in the least-squares adjustment): 1970Bl02	1970Ea02	1974Ru02	1975Da16
939.5 *3*		939.1 *9*	939.5 *7*	939.3 *5*	939.5 *4*
1068.2 *5*		1068.4 *10*	1069.3 *8*	1069.2 *5*	1067.6 *3*
1302.7 *7*		1302.7 *10*	1300.3 *12*	1303.3 *5*	1302.7 *6*
1662.36 *24*		1661.8 *7*		1662.0 *5*	1662.6 *3*

E(level)†	Jπ‡	$T_{1/2}$	Comments
0.0	7/2−		
12.46# *14*	3/2+	0.305 s *17*	$T_{1/2}$: from 1964Ho14 (E(p)=2.7 MeV. γ(t),NaI).
376.59@ *19*	3/2−	&	
543.06# *14*	5/2+	5.3 ps *10*	$T_{1/2}$: 101 ps *28* (1980Bu08; RDM) not adopted since the value is discrepant with DSAM In (p,p′γ) and (α,pγ), B(E1)↑ In Coul. ex., and Γ In (γ,γ). Other: >0.55 ps (1980Bu08; DSAM).
720.43@ *13*	5/2−	193 fs *22*	
939.5b *3*	1/2+	>2.6a ps	

974.54[#] *11*	$7/2^+$	2.49 ps *35*	
1068.2 *5*	$3/2^-$	0.45 ps *16*	
1236.90 *15*	$11/2^-$	1.60 ps *34*	
1302.7[b] *7*	$3/2^+$	2.3[a] ps *+8−5*	$T_{1/2}$: other:>5.5 ps (1980Bu08).

Continued on next page (footnotes at end of table)

^{45}Sc(p,p′γ) (continued)

^{45}Sc Levels (continued)

E(level)[†]	Jπ[‡]	$T_{1/2}$	Comments
1409.12[@] *23*	(7/2)$^-$	257 fs *+23−18*	$T_{1/2}$: other: 0.6 ps *3* (1974Ru02; DSAM).
1433.85[#] *19*	9/2$^+$	1.9[d] ps *13*	
1555.8 *7*	(3/2)$^-$		
1662.36[@] *24*	9/2$^-$	95 fs *7*	
1800.3[b] *4*	5/2$^+$	76[a] fs *+12−7*	$T_{1/2}$: consistent with data from (α,pγ), (n,n′γ), and (p,γ). Other: 8 fs *7* (1980Bu08; DSAM).
1935.5 *10*		32[c] fs *+16−11*	
1935.6?		61[c] fs *+22−16*	state and associated gammas reported only by 1985Av04.
2030.83[#] *22*	11/2$^+$	0.48[d] ps *17*	Additional information 1.
2091.1 *9*	5/2	<7.6[a] fs	$T_{1/2}$: consistent with data from (p,γ), (α,pγ), and (n,n′γ). Other: 62 fs *14* (1980Bu08; DSAM).
2106.5	15/2$^-$	>1.4[c] ps	
2138.5	3/2$^-$,5/2	0.31 ps *+9−7*	$T_{1/2}$: see comment on 2138γ.
2152.1?			state and associated gammas reported only by 1980Bu08.
2220.1 *13*	(3/2$^-$,5/2)		state and associated gammas observed only by 1975Da16 In (p,p′γ). 2208γ from the 2220 state probably corresponds to 2209γ observed by 1972Ek02 In (p,γ).
2224.2	5/2$^+$,7/2$^+$	0.42[d] ps *18*	Additional information 2.
2289.8 *7*	(7/2$^-$,9/2)	0.21 ps *7*	
2305.11 *17*	(5/2$^-$)		
2321.5 *10*	3/2$^-$,5/2,7/2$^+$	45[c] fs *+11−7*	
2341.7 *10*	(7/2$^-$)	26[e] fs *11*	
2351.7 *10*	3/2$^-$,5/2	194[de] fs *56*	
2531.1	(1/2$^+$,3/2,5/2)	21[a] fs *5*	
2592.2 *4*	3/2$^-$,5/2,7/2$^-$	10[a] fs *5*	
2778.7	(1/2$^-$,3/2,5/2)	<20[a] fs	
3022.7? *3*	1/2$^-$,3/2$^-$		

[†] From least-squares fit to Eγ′s, except As noted. Transitions without ΔE_γ′s were not included unless they were the only transitions connecting the states.

[‡] From the Adopted Levels.

[#] Band(A): $K^\pi=3/2^+$ band. Based on J(J+1) energy dependence and enhanced B(E2)(W.u.)′s (1985Av04).

[@] Band(B): $K^\pi=3/2^-$ band. Based on J(J+1) energy dependence and enhanced B(E2)(W.u.)′s (1985Av04).

[&] 101 ps *28* (1980Bu08; RDM) and 3.5 ps *13* (1983Ra17; DSAM. Weighted av of 2.8 ps *+22−10* At E(p)=3.0 MeV and 6.2 ps *+46−21* At E(p)=4.5 MeV) were not adopted since the values are discrepant with $T_{1/2}$=43.3 ps *23* from the unweighted av B(E2)↑=0.0071 *4* of seven B(E2)↑ values ranging from 0.0060 *10* to 0.0086 *17* In Coul. ex. Note also that the $T_{1/2}$ from 1983Ra17 would result In B(E2)(W.u.)(377γ)=1.8×10^2 *7* which, while within the RUL for α=45-90, seems large compared to the systematics of the α=45-67 region where only 21 transitions out of 375 exceed 32 W.u. (1979En04). Other: >1.1 ps (1974Ru02; DSAM). Also, $T_{1/2}$(543)=105 ps *28* (1980Bu08; RDM) is discrepant with DSA measurements In (p,p′γ) and (α,pγ), B(E1)↑ in Coulomb excitation, and Γ In (γ,γ).

[a] From 1983Ra17 (DSAM; E(p)=4.5 MeV). $T_{1/2}$(940)>2.6 ps At E(p)=3.0 MeV and>7.7 ps At E(p)=4.5 MeV.

[b] Band(C): $K^\pi=1/2^+$ band? based on J(J+1) energy dependence and enhanced B(E2)(W.u.)′s (1985Av04).

[c] From 1985Av04 (DSAM).

[d] From 1980Bu08 (DSAM).

[e] See footnote on the 2342 and 2352 states In the Adopted Levels.

^{45}Sc(p,p′γ) (continued)

γ(^{45}Sc)

1966Jo04 compared Iγ(12γ) and Iγ(K x ray) (E=1.2 and 1.9 MeV; pc).
Unplaced γ′s with Eγ=292.5, 1843.1, 2678.8, and 2837.3 reported by 1968Ch25 have not been confirmed.
Placement of γ′s are considered uncertain if not confirmed by other works or if all authors have noted that the placement is uncertain.
Coincidence data are from 1970Ea02 and 1968Ch25.
α(K)exp: from 1970Ea02, except As noted. Normalized to α(K)exp(662γ; ^{137}Ba) and α(K)exp(279γ; ^{197}Au) from 1966Ha50). Corrected for angular distribution effects, except As noted. The evaluator could not renormalize since 1970Ea02 did not detail their normalization procedure. However, 1966Ha50 cite α(662γ; ^{137}Ba)=0.0915, BrIcc (2005KiZT) yields 0.09148, and α(K)exp(662γ; ^{137}Ba)=0.09107 *29* (2007KiZZ).

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.[#]	δ[#]	α(exp)[@]	Comments
12.46	3/2+	13 *1*	100	0.0	7/2−	(M2)			α(K)exp=413 *37* (1966Jo04) E_γ: from 1964Ho14 (E(p)=2.7 MeV. γ(t),NaI).
376.59	3/2−	364.35 *33*	100[&]	12.46	3/2+	(E1(+M2))	−0.01 *8*	5.09×10^{-4}	α(K)exp=5.3×10^{-4} *14* Mult.,α(exp): from the adopted γ′s. Assumed by the evaluator to normalize α. 1970Bl02 used α=0.00045.
		376.94 *49*	8.8[&] *4*	0.0	7/2−	E2		2.7×10^{-4} *7*	α(K)exp≈0.002 α(K)exp: not corrected for anisotropy.
543.06	5/2+	166.0[i] *7*	≤1.0[†]	376.59	3/2−				
		530.66 *17*	100[&]	12.46	3/2+	M1(+E2)	−0.04 *+4−51*	3.1×10^{-4} *6*	α(K)exp=3.7×10^{-4} *9*
		543.09 *23*	72.0[&] *15*	0.0	7/2−	E1		1.6×10^{-4} *5*	α(K)exp=2.9×10^{-4} *10*
720.43	5/2−	720.34 *15*	100[&]	0.0	7/2−	M1(+E2)			α(K)exp=1.4×10^{-4} *3* Mult.: from α(K)exp and Coul. ex. (1970Ea02). δ: 0≤δ≤1.0 or −0.1≤δ≤0.0 from α(K)exp and Coul. ex. (1970Ea02).
939.5	1/2+	563.7 *8*	83[†] *24*	376.59	3/2−				
		926.83[h] *42*	100[h†] *27*	12.46	3/2+				
974.54	7/2+	431.71 *23*	17.6 *10*	543.06	5/2+	M1+E2	1.12 *18*	8.1×10^{-4} *29*	
		962.02 *14*	54.0 *20*	12.46	3/2+				
		974.39 *14*	100[&]	0.0	7/2−				
1068.2	3/2−	347.36 *33*	25[&] *6*	720.43	5/2−				I_γ: Iγ(348γ)/Iγ(691γ)=0.47 (1980Bu08) discrepant.
		691.11 *49*	100[&]	376.59	3/2−				
1236.90	11/2−	1237.13[h] *18*	100[h†]	0.0	7/2−				
1302.7	3/2+	760.2 *7*	100	543.06	5/2+				
		926.83[h] *42*	45[h]	376.59	3/2−				
		1289.6 *8*	16	12.46	3/2+				I_γ: other authors give Iγ(760γ)/Iγ(1290γ)≈1. 1983Ra17 did not consider the 1290γ In their DSAM measurements.

$^{45}_{21}Sc_{24}$-4

^{45}Sc(p,p′γ) (continued)

γ(^{45}Sc) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	α(exp)[@]	Comments
1409.12	(7/2)$^-$	688.9 *5*	11	720.43	5/2$^-$		
		1032.79[h] *39*	3.1[ha] *2*	376.59	3/2$^-$		I_γ: Iγ(1033γ)/Iγ(1409γ)=0.07 (1980Bu08) discrepant.
		1409.08 *42*	100[a] *6*	0.0	7/2$^-$		
1433.85	9/2$^+$	197.53 *29*	4	1236.90	11/2$^-$		
		459.19 *25*	25	974.54	7/2$^+$	9.9×10^{-4} *23*	
		889.8 *6*	100	543.06	5/2$^+$		
		1056.7[bi] *10*	5.8[b] *17*	376.59	3/2$^-$		
		1433.6 *6*	11	0.0	7/2$^-$		
1555.8	(3/2)$^-$	487.6 *7*	100	1068.2	3/2$^-$		
1662.36	9/2$^-$	253.76 *45*	13[†] *6*	1409.12	(7/2)$^-$		
		425.40 *48*	19[†] *4*	1236.90	11/2$^-$		
		942.0 *6*	14[†] *8*	720.43	5/2$^-$		
		1661.9 *10*	100[†] *13*	0.0	7/2$^-$		
1800.3	5/2$^+$	497.7[‡i]	31	1302.7	3/2$^+$		
		733.3[‡]	8	1068.2	3/2$^-$		
		1080.9[‡]	8	720.43	5/2$^-$		
		1257.17 *49*	62	543.06	5/2$^+$		
		1424.5[‡]	23	376.59	3/2$^-$		
		1788.1 *6*	100	12.46	3/2$^+$		
		1800.1 *6*	26	0.0	7/2$^-$		
1935.5		1935.5[b] *10*	100[b]	0.0	7/2$^-$		
1935.6?		1559[cdi]		376.59	3/2$^-$		
2030.83	11/2$^+$	597.4 *5*	100[†] *50*	1433.85	9/2$^+$		
		794.15 *47*	10[†] *3*	1236.90	11/2$^-$		
		1056.14 *23*	85[†] *11*	974.54	7/2$^+$		
2091.1	5/2	1026.2[‡]	17	1068.2	3/2$^-$		
		1717.4[‡]	13	376.59	3/2$^-$		
		2091.0[‡] *9*	100	0.0	7/2$^-$		
2106.5	15/2$^-$	869.6[‡]	100	1236.90	11/2$^-$		
2138.5	3/2$^-$,5/2	2138.4[c]		0.0	7/2$^-$		2139γ assigned to 2151 state by 1983Ra17; however, $T_{1/2}$ (1983Ra17) is inconsistent with $T_{1/2}$(2151) In (p,γ) but is consistent with $T_{1/2}$ (1985Av04) for the 2138 state.
2152.1?		596.4[‡di]	100	1555.8	(3/2)$^-$		
		1084.0[‡di]	52	1068.2	3/2$^-$		
		1608.8[‡di]	98	543.06	5/2$^+$		
2220.1	(3/2$^-$,5/2)	2207.6[d] *13*	100[†] *22*	12.46	3/2$^+$		
		2220.6[di] *18*	48[†] *22*	0.0	7/2$^-$		
2224.2	5/2$^+$,7/2$^+$	790.7[‡]	56	1433.85	9/2$^+$		

^{45}Sc(p,p′γ) (continued)

γ(^{45}Sc) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Comments
2224.2	5/2$^+$,7/2$^+$	920.8[‡]	26	1302.7	3/2$^+$	
		1504.0[‡]	100	720.43	5/2$^-$	
		1681.2[‡]	74	543.06	5/2$^+$	
		2212[ci]		12.46	3/2$^+$	May correspond to 2208γ assigned to 2220 state by 1975Da16.
		2224[ci]		0.0	7/2$^-$	May correspond to 2221γ assigned to 2220 state by 1975Da16.
2289.8	(7/2$^-$,9/2)	1049.2[‡b] *10*	82	1236.90	11/2$^-$	originally assigned to the 2352 state based on coincidence with an≈1260γ and previously known state At 2351. 1985Av04 also assigned a 1049γ to the 2352 state along with a 1055γ to the 2290 state. Evaluator believes that there is only one γ and it should Be assigned to the 2290 state.
		1316.0[i] *5*	58[†] *11*	974.54	7/2$^+$	
		2289.7 *7*	100[†] *13*	0.0	7/2$^-$	
2305.11	(5/2$^-$)	641.08 *47*	25[†] *8*	1662.36	9/2$^-$	
		1237.13[h] *18*	100[h†] *49*	1068.2	3/2$^-$	
2321.5	3/2$^-$,5/2,7/2$^+$	2308.8 *13*	100[†] *15*	12.46	3/2$^+$	
		2321.7 *14*	44[†] *15*	0.0	7/2$^-$	
2341.7	(7/2$^-$)	931.34[gi] *32*	≤154[g†]	1409.12	(7/2)$^-$	
		2341.6[e] *10*	100[†] *16*	0.0	7/2$^-$	
2351.7	3/2$^-$,5/2	796.4[‡e]	59	1555.8	(3/2)$^-$	
		1631.0[be] *15*	100[b] *20*	720.43	5/2$^-$	
		2350.4[bei] *10*	5.4[b] *11*	0.0	7/2$^-$	
2531.1	(1/2$^+$,3/2,5/2)	1988[f]		543.06	5/2$^+$	
2592.2	3/2$^-$,5/2,7/2$^-$	1032.79[hi] *39*	≤35[h†]	1555.8	(3/2)$^-$	
		1524.48 *43*	61[†] *18*	1068.2	3/2$^-$	
		1869.7 *15*	17[†] *13*	720.43	5/2$^-$	
		2212.7 *13*	100[†] *22*	376.59	3/2$^-$	
		2590[fi]		0.0	7/2$^-$	May correspond to 2590γ assigned to 2601 state by 1972Ek02 In (p,γ).
2778.7	(1/2$^-$,3/2,5/2)	2402[f]		376.59	3/2$^-$	
3022.7?	1/2$^-$,3/2$^-$	803.5[i] *6*	100[†] *38*	2220.1	(3/2$^-$,5/2)	
		931.34[gi] *32*	≤562[g†]	2091.1	5/2	

[†] From 1975Da16, except As noted.
[‡] From 1980Bu08, except As noted. Relative photon branching ratio from each state.
[#] From α(exp) and α(K)exp, except As noted.
[@] From 1970Bl02, except As noted. Renormalized by evaluator.

$^{45}_{21}Sc_{24}$-6

^{45}Sc(p,p′γ) (continued)

$\gamma(^{45}Sc)$ (continued)

[&] From 1970Bl02.
[a] From 1974Ru02.
[b] From 1968Ch25.
[c] From 1985Av04.
[d] See comment on the associated state.
[e] See footnote on the 2342 and 2352 states In the Adopted Levels.
[f] From 1983Ra17.
[g] Multiply placed with undivided intensity.
[h] Multiply placed with intensity suitably divided.
[i] Placement of transition in the level scheme is uncertain.

$^{45}_{21}Sc_{24}$-7

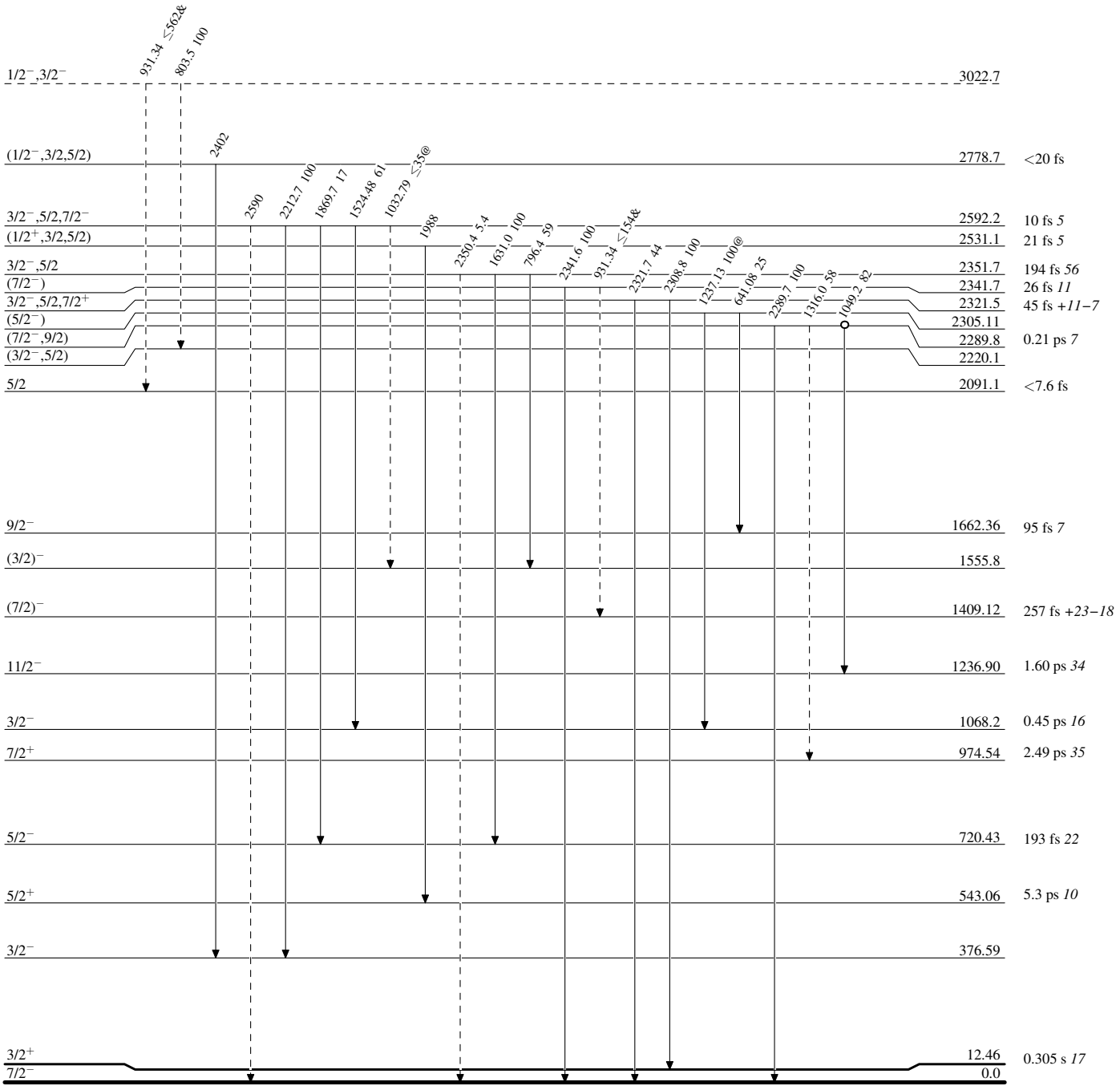
^{45}Sc(p,p′γ)

Legend

Level Scheme

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

γ Decay (Uncertain)
Coincidence
Coincidence (Uncertain)



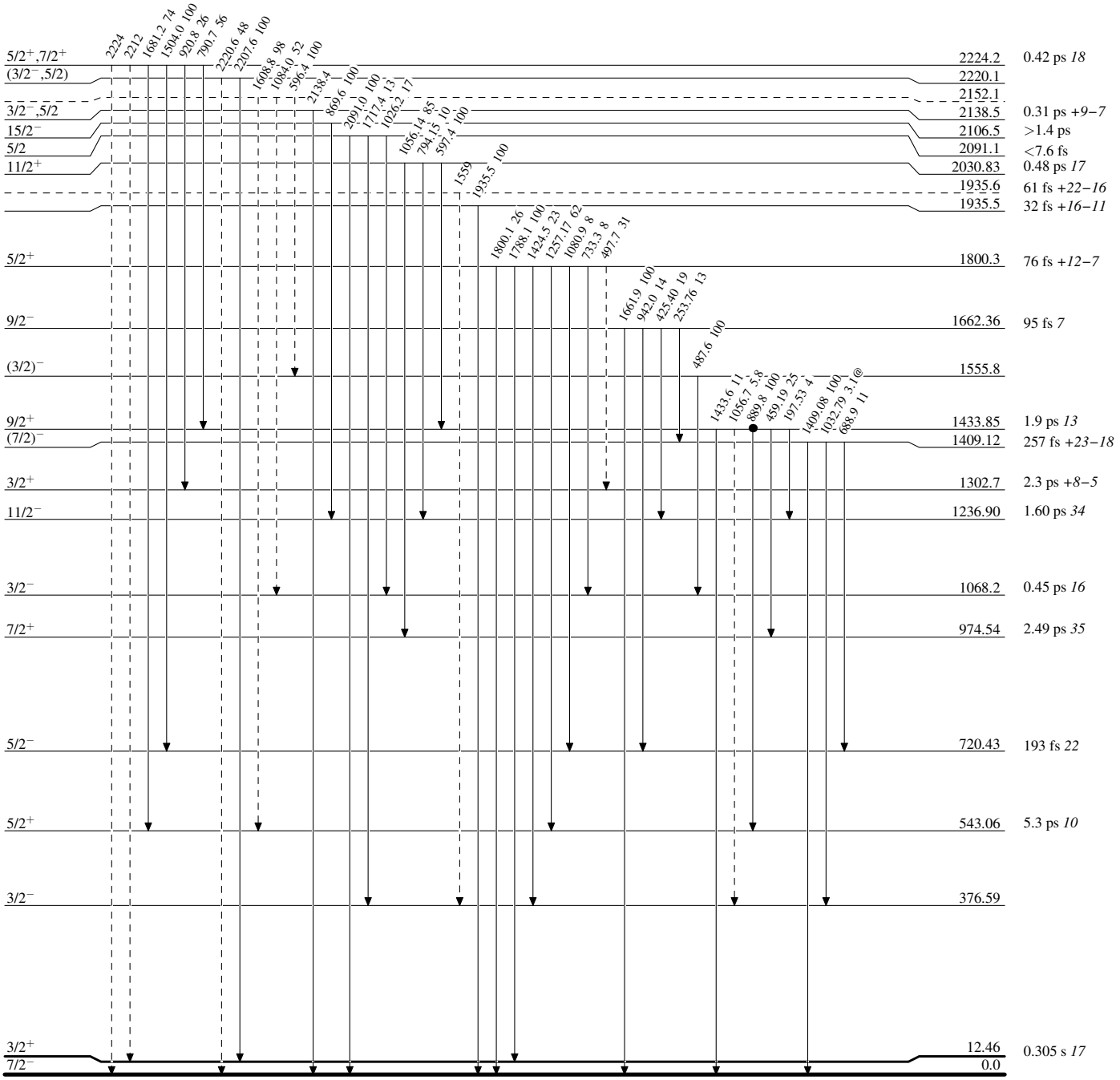
$^{45}_{21}Sc_{24}$

^{45}Sc(p,p′γ)

Level Scheme (continued)

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

Legend
γ Decay (Uncertain)
Coincidence



$^{45}_{21}Sc_{24}$

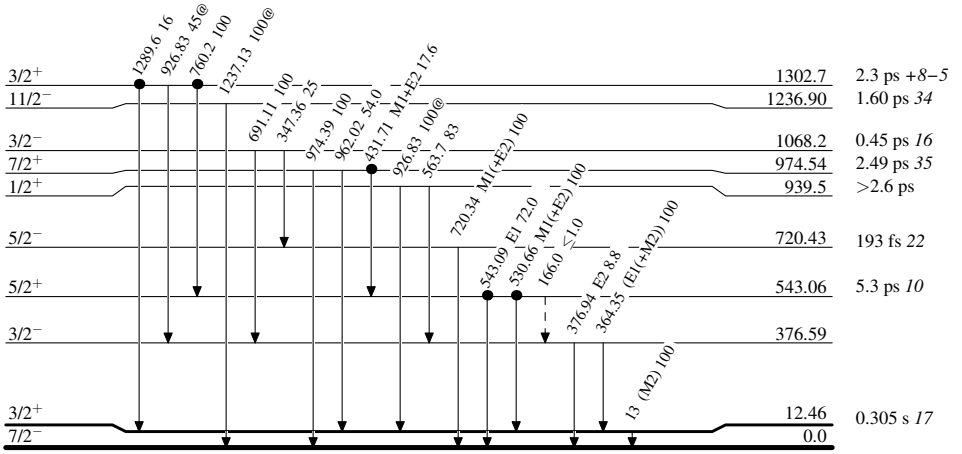
^{45}Sc(p,p′γ)

Legend

Level Scheme (continued)

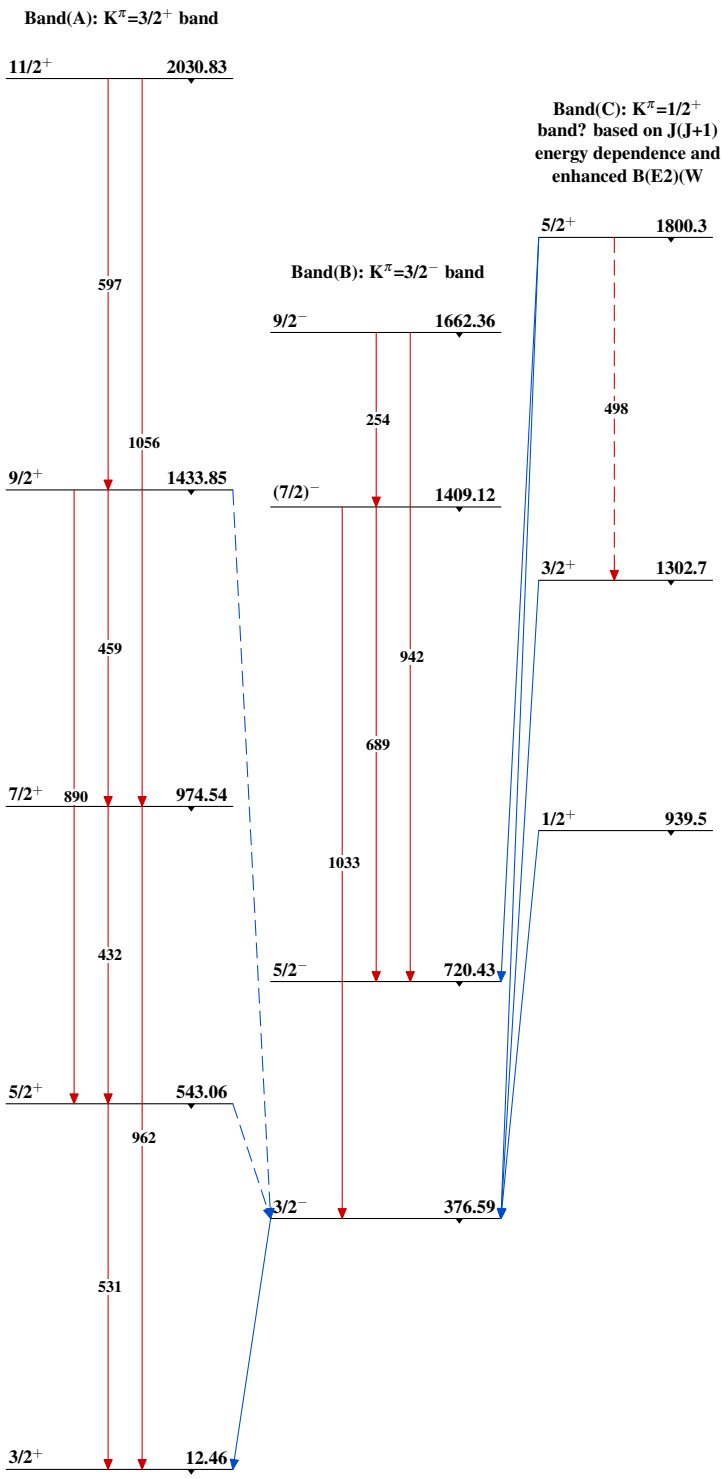
Intensities: Relative photon branching from each level
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided

γ Decay (Uncertain)
Coincidence



$^{45}_{21}Sc_{24}$

^{45}Sc(p,p′γ)



$^{45}_{21}Sc_{24}$