^{48}Ti(α,nγ) 1980Ka10,1973Sa12,1973Sz01

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Wang Jimin and Huang Xiaolong	NDS 144, 1 (2017)	1-Mar-2016

Others: 1974En04, 1978Ka32.
1980Ka10: E=8.08 MeV, measured σ(Eγ,$\theta\gamma$), linear polarization, DSA, $\gamma\gamma$ coin. All the cascade transitions except the 28 keV (777 to 749) transition have been confirmed in $\gamma\gamma$ coin.
1978Ka32: same authors as 1980Ka10.
1973Sa12: E=10.2-14.2 MeV; $\gamma\gamma$ coin, $\gamma(\theta)$.
1973Sz01: E=6.5, 7.5, 8.5 MeV; DSA.
1974En04: E=12 MeV, recoil distance.
Decay scheme from 1980Ka10.

^{51}Cr Levels

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$[c]	Comments
0.0[b]	7/2$^-$		
749.19[a] *16*	3/2$^-$	7.25 ns *25*	μ=−0.86 *12* T$_{1/2}$: from 1974Ko10. μ: From $\gamma(\theta$,H,t) relative to 197 level in ^{19}F (1974Ko10). Value is an average of −0.78 *13* from this reaction and −0.95 *10* from (d,pγ).
776.9[a] *5*	(1/2)$^-$		
1164.87[b] *21*	9/2$^-$	76 fs *7*	
1352.59[a] *21*	5/2$^-$	3.8 ps *+24−14*	T$_{1/2}$: other: 0.38 ps *+17−10* (1973Sz01).
1480.43[b] *21*	11/2$^-$	0.55 ps *+24−4*	
1557.14[a] *19*	7/2$^-$	4.2 ps *+17−10*	T$_{1/2}$: other: >2.8 ps (1973Sz01).
1899.0 *5*	3/2$^-$	0.29 ps *+3−2*	T$_{1/2}$: average of 0.38 ps *+8−6* (1973Sz01) and 0.28 ps *3* (1980Ka10).
2003.1 *4*	5/2$^-$	24 fs *10*	T$_{1/2}$: average of 27 fs *+13−12* (1973Sz01) and 21 fs *14* (1980Ka10).
2255.8[b] *3*	15/2$^-$	45.8[d] ps *14*	T$_{1/2}$: other: >0.7 ps (1973Sz01).
2313.0 *5*	7/2$^-$	21 fs *+7−5*	T$_{1/2}$: from 1973Sz01. Other: <21 fs (1980Ka10).
2379.2[a] *5*	9/2$^-$	0.42 ps *+14−10*	T$_{1/2}$: other: 0.38 fs *+14−10* (1973Sz01).
2385.7[b] *4*	13/2$^-$	56 fs *+14−12*	T$_{1/2}$: average of 66 fs *+21−14* (1973Sz01) and 42 fs *21* (1980Ka10).
2704.6[a] *4*	11/2$^-$	>416 fs	T$_{1/2}$: from 1980Ka10. Other: 234 fs *+24−21* (1973Sz01) is wrong because the 1148γ used by 1973Sz01 is a triplet.
2762.3 *7*	1/2$^+$[@]	0.071 ps *10*	T$_{1/2}$: average of 0.069 ps *10* (1973Sz01) and 0.10 ps *4* (1980Ka10).
2769.5 *6*	9/2$^-$	49 fs *+14−12*	T$_{1/2}$: from 1973Sz01. Other: 69 fs *+69−49* (1980Ka10).
2828.1 *7*	(3/2)$^-$	59 fs *+12−10*	T$_{1/2}$: average of 40 fs *+21−17* (1973Sz01) and 69 fs *14* (1980Ka10).
2889.9 *6*	3/2$^-$	0.35 ps *+5−3*	T$_{1/2}$: average of 0.35 ps *+6−4* (1973Sz01) and 0.35 ps *+9−6* (1980Ka10).
2910.3 *6*	(5/2)$^-$[@]	30[e] fs *+19−10*	T$_{1/2}$: other: 35 fs *+70−35* (1980Ka10).
2948.1 *6*	5/2$^-$	0.119 ps *+13−10*	T$_{1/2}$: average of 0.118 ps *+14−10* (1973Sz01) and 0.125 ps *+35−28* (1980Ka10).
3002.5 *7*	5/2$^-$	15[e] fs *+5−4*	T$_{1/2}$: other: <30 fs (1980Ka10).
3003.7 *8*	3/2$^+$	0.34 ps *4*	T$_{1/2}$: other: 0.33 ps *+6−4* (1973Sz01).
3018.8 *6*	11/2$^-$	49 fs *+21−15*	T$_{1/2}$: from 1973Sz01. other:<28 fs (1980Ka10).
3056.1 *7*	(1/2$^-$)	69 fs *35*	
3108.0 *6*	7/2$^-$	54 fs *+12−16*	T$_{1/2}$: average of 49 fs *+21−15* (1973Sz01) and 62 fs *+14−28* (1980Ka10).
3126.8 *7*	3/2$^-$	83 fs *+14−28*	
3135.1[#] *10*	(3/2$^-$)[@]	45[e] fs *+20−19*	
3181.0 *6*	(17/2)$^-$[&]		
3204.1[#] *10*		43[e] fs *+21−18*	
3207.9 *11*	7/2$^-$,9/2$^-$[@]	55 fs *14*	
3262.7 *8*	(3/2$^-$)[@]	31[e] fs *+15−12*	T$_{1/2}$: other: <70 fs (1980Ka10).
3267.2 *8*			

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^{48}Ti(α,nγ) 1980Ka10,1973Sa12,1973Sz01 (continued)

^{51}Cr Levels (continued)

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$[c]	Comments
3345.7 *8*			
3350.9 *6*	3/2$^-$,5/2$^-$,7/2$^-$		
3447.9 *9*	13/2$^-$	<70 fs	
3578.8 *11*	(11/2,13/2,15/2)[@]	<70 fs	
3771.1 *8*	1/2$^-$,3/2$^-$[@]	<28 fs	
3830.7 *8*	(7/2,9/2,11/2)$^-$[@]	30[e] fs *+8–6*	T$_{1/2}$: other: <35 fs (1980Ka10).
3871.0 *11*			
3900.1 *8*	(5/2$^+$)[@]	55[e] fs *+21–15*	T$_{1/2}$: other: <35 fs (1980Ka10).
3927.2[#] *20*	(5/2$^+$)[@]	<25[e] fs	
3934.0 *11*			
3953.2 *8*	(5/2$^+$)[@]	31[e] fs *+10–7*	T$_{1/2}$: other: <35 fs (1980Ka10).
3977.4 *6*	3/2$^+$,5/2$^+$[@]	<35 fs	
3985.3 *6*	(5/2$^+$)[@]	22[e] fs *+5–4*	T$_{1/2}$: other: <35 fs (1980Ka10).
4005.6 *8*	5/2$^-$,7/2$^-$[@]		
4017.2 *8*	(3/2$^-$,5/2,7/2$^-$)[@]	21[e] fs *+10–9*	
4030			
4056			
4071.2 *6*	5/2$^+$,7/2$^+$[@]	<40[e] fs	
4107.3 *8*			J$^\pi$: J^π=(7/2$^+$) (1980Ka10).
4111.3 *7*			
4120.2 *11*			
4136.5 *8*			
4161.6 *8*			J$^\pi$: J^π=(9/2$^+$) (1980Ka10).
4182.0 *11*			
4189.2 *10*	5/2$^+$,7/2$^+$[@]		
4239.2 *10*			
4254.2 *10*			
4354.3 *13*	(1/2$^-$,3/2$^-$)[@]		
4405.4 *13*			

[†] E(level) values are from 1973Sz01, where available, or from the level scheme of 1980Ka10 for the other levels. Values of 1973Sz01 are based on a least-squares fit to their Eγ values. It would be reasonable to assign an uncertainty of 1 keV to values of 1980Ka10.
[‡] Based on $\gamma(\theta)$, γ linear polarization, and multipolarity (1978Ka32,1980Ka10).
[#] From 1973Sz01.
[@] From Adopted Levels.
[&] From excit in 1973Sa12.
[a] Band(A): Strongly deformed K$^\pi$=1/2$^-$ band. Member of band: 1/2$^-$ to 11/2$^-$ (1980Ka10).
[b] Band(B): Deformed K$^\pi$=7/2$^-$ band. Member of band: 7/2$^-$ to 13/2$^-$ (1980Ka10).
[c] From DSA measurement in 1980Ka10, except as noted.
[d] From RDM (1974En04).
[e] From DSA measurement (1973Sz01).

^{48}Ti(α,nγ) 1980Ka10,1973Sa12,1973Sz01 (continued)

$\gamma(^{51}Cr)$

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.[#]	δ[@]	Comments
749.19	3/2$^-$	749.0 *2*	100	0.0	7/2$^-$	E2[b]		δ: δ(M3,E2)=0.00 *2* (1973Sa12). $\gamma(\theta)$: A_2=+0.049 *2*, A_4=+0.007 *2* (1973Sa12).
776.9	(1/2)$^-$	28	100	749.19	3/2$^-$	M1		E_γ: seen only by 1980Sa07, value is from E(level) difference. Mult.: from an intensity balance, 1980Sa07 determine α(exp)=1.3 *4*. This is consistent with E1 or with M1+E2 with δ<0.12. From RUL one expects δ<0.026, and from Adopted Levels one has $\Delta\pi$=no.
1164.87	9/2$^-$	1164.6 *3*	100	0.0	7/2$^-$	M1+E2	−0.17 *+1−2*	$\gamma(\theta)$: A_2=−0.503 *6*, A_4=−0.001 *9*, γ(Pol)=−0.4 to −0.1 (1973Sa12). δ: from 1973Sa12. Other: −0.19 *+4−2* (1980Ka10).
1352.59	5/2$^-$	575.5	10 *2*	776.9	(1/2)$^-$	E2[b]		δ: δ(M3,E2)=0.00 *6* (1978Ka32).
		603.5 *3*	60 *4*	749.19	3/2$^-$	M1+E2[b]	+0.40[b] *+8−4*	$\gamma(\theta)$: A_2=+0.053 *9*, A_4=+0.009 *28* (1973Sa12). δ: other: −0.18 *4* (1973Sa12).
		1352.8 *3*	30 *3*	0.0	7/2$^-$	M1(+E2)[b]	+0.06[b] *+6−9*	
1480.43	11/2$^-$	315.6 *2*	53 *4*	1164.87	9/2$^-$	D(+Q)[a]	+0.03[a] *3*	$\gamma(\theta)$: A_2=−0.307 *14*, A_4=+0.037 *19* (1973Sa12).
		1480.3 *3*	47 *4*	0.0	7/2$^-$	E2		δ: δ(M3,E2)=0.00 *2* (1973Sa12), −0.02 *2* (1980Ka10). $\gamma(\theta)$: A_2=+0.341 *20*, A_4=−0.098 *18*, γ(Pol)=+0.3 to 1.0 (1973Sa12).
1557.14	7/2$^-$	204	5 *2*	1352.59	5/2$^-$	[M1][b]		
		807.9 *2*	81 *4*	749.19	3/2$^-$	E2		δ: δ(M3,E2)=0.00 *3* (1978Ka32), δ(M3,E2)=0.00 *5* (1973Sa12). $\gamma(\theta)$: A_2=+0.281 *21*, A_4=−0.067 *22* (1973Sa12).
		1558.0[a] *8*	14 *2*	0.0	7/2$^-$	M1+E2[b]	−0.38[b] *11*	
1899.0	3/2$^-$	1149	22 *2*	749.19	3/2$^-$			
		1899	78 *2*	0.0	7/2$^-$	E2		Mult.: From $\gamma(\theta)$, γ(pol) in 1980Ka10 and RUL.
2003.1	5/2$^-$	2003	100	0.0	7/2$^-$	M1+E2	−0.09 *6*	Mult.: From $\gamma(\theta)$ & γ(pol) in 1980Ka10 and RUL. Polarization: −0.05 *5* (1980Ka10).
2255.8	15/2$^-$	775.4 *2*	100	1480.43	11/2$^-$	E2[a]		B(E2)↓=3.94 *12* (1974En04) δ: δ(M3,E2)=0.00 *2* (1973Sa12). $\gamma(\theta)$: A_2=+0.37 *2*, A_4=−0.12 *2* (1974En04).
2313.0	7/2$^-$	1147.9[d] *4*	85[d] *3*	1164.87	9/2$^-$	[M1]		
		2314	15 *3*	0.0	7/2$^-$	[M1]		
2379.2	9/2$^-$	822	13 *2*	1557.14	7/2$^-$	[M1]		E_γ: Only observed in 1978Ka32.
		899	18 *3*	1480.43	11/2$^-$	M1(+E2)[b]	+0.02[b] *+14−13*	
		1027	26 *3*	1352.59	5/2$^-$	E2[b]		δ: δ(M3,E2)=+0.02 *+13−12* (1978Ka32).
		1214	15 *2*	1164.87	9/2$^-$	M1+E2[b]		
		2379[d]	28[d] *3*	0.0	7/2$^-$	M1+E2[b]		
2385.7	13/2$^-$	905.3 *3*	100	1480.43	11/2$^-$	M1+E2	−0.07[a] *2*	δ: other: −0.10 *5* (1980Ka10). $\gamma(\theta)$: A_2=−0.383 *6*, A_4=−0.005 *11* (1973Sa12).

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^{48}Ti(α,nγ) 1980Ka10,1973Sa12,1973Sz01 (continued)

$\gamma(^{51}Cr)$ (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.[#]	δ[@]	Comments
2704.6	11/2$^-$	1147.9[d] *4*	74[d] *4*	1557.14	7/2$^-$	E2[b]		
		1224.9	14 *1*	1480.43	11/2$^-$	M1(+E2)[b]	+0.3[b] *+8−5*	
		1540.5[c] *8*	9 *1*	1164.87	9/2$^-$	M1(+E2)[b]	−0.09[b] *+39−24*	
		2705.0[c]	3 *1*	0.0	7/2$^-$			
2762.3	1/2$^+$	2013	100	749.19	3/2$^-$	[E1]		Mult.: From level scheme.
2769.5	9/2$^-$	1289	22 *2*	1480.43	11/2$^-$	M1+E2	+0.07 *+16−14*	Mult.: From $\gamma(\theta)$ & γ(pol) in 1980Ka10 and RUL. Polarization: −0.20 *20* (1980Ka10).
		1605	27 *2*	1164.87	9/2$^-$	[M1]		
		2769	51 *3*	0.0	7/2$^-$			
2828.1	(3/2)$^-$	825	38 *5*	2003.1	5/2$^-$			
		929	8 *5*	1899.0	3/2$^-$			
		2079	54 *8*	749.19	3/2$^-$	D(+Q)	+0.09 *+30−25*	Mult.: From $\gamma(\theta)$ in 1980Ka10.
2889.9	3/2$^-$	888	17 *4*	2003.1	5/2$^-$			
		990	36 *4*	1899.0	3/2$^-$			
		1538.0[c] *8*	31 *5*	1352.59	5/2$^-$			
		2112	16 *3*	776.9	(1/2)$^-$			
2910.3	(5/2)$^-$	1353	58 *7*	1557.14	7/2$^-$			
		1557	6 *4*	1352.59	5/2$^-$			
		2161	11 *2*	749.19	3/2$^-$			
		2911	25 *3*	0.0	7/2$^-$			
2948.1	5/2$^-$	1049	31 *2*	1899.0	3/2$^-$			
		1391	36 *2*	1557.14	7/2$^-$	D(+Q)	−0.22 *+22−26*	Mult.: From $\gamma(\theta)$ in 1980Ka10.
		2948	33 *2*	0.0	7/2$^-$			
3002.5	5/2$^-$	3003	100	0.0	7/2$^-$	M1(+E2)	−0.07 *+7−10*	Mult.: From $\gamma(\theta)$ & γ(pol) in 1980Ka10 and RUL. Polarization: −0.009 *13* (1980Ka10).
3003.7	3/2$^+$	1000	55 *3*	2003.1	5/2$^-$	M1(+E2)	+0.12 *+23−19*	Mult.: From $\gamma(\theta)$ & γ(pol) in 1980Ka10 and RUL. Polarization: −0.00 *5* (1980Ka10).
		2255	45 *3*	749.19	3/2$^-$	M1(+E2)		Mult.: From $\gamma(\theta)$ & γ(pol) in 1980Ka10 and RUL. −0.04<δ<+3.7 (1980Ka10).
3018.8	11/2$^-$	633	18 *3*	2385.7	13/2$^-$	[M1]		
		1538	6 *3*	1480.43	11/2$^-$	[M1]		
		1853	19 *3*	1164.87	9/2$^-$	[M1]		
		3020	57 *8*	0.0	7/2$^-$	[E2]		
3056.1	(1/2$^-$)	1157	22 *6*	1899.0	3/2$^-$	[M1]		
		2280	54 *15*	776.9	(1/2)$^-$			
		2306	24 *6*	749.19	3/2$^-$			
3108.0	7/2$^-$	1105	51 *10*	2003.1	5/2$^-$			
		1943	29 *6*	1164.87	9/2$^-$	D(+Q)	−0.18 *+27−21*	Mult.: From $\gamma(\theta)$ in 1980Ka10.
		3108	20 *5*	0.0	7/2$^-$			
3126.8	3/2$^-$	1123	19 *4*	2003.1	5/2$^-$			
		2350	26 *4*	776.9	(1/2)$^-$			
		2379[d]	55[d] *5*	749.19	3/2$^-$			
3135.1	(3/2$^-$)	3135[&]	100	0.0	7/2$^-$			
3181.0	(17/2)$^-$	925.2 *5*	100	2255.8	15/2$^-$			
3204.1		3204[&]	100	0.0	7/2$^-$			
3207.9	7/2$^-$,9/2$^-$	2043	100	1164.87	9/2$^-$	D+Q	−0.42 *+15−28*	Mult.: From $\gamma(\theta)$ in 1980Ka10.
3262.7	(3/2$^-$)	2514	58 *4*	749.19	3/2$^-$			
		3262	42 *4*	0.0	7/2$^-$			
3267.2		1787	86 *6*	1480.43	11/2$^-$			

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^{48}Ti(α,nγ) 1980Ka10,1973Sa12,1973Sz01 (continued)

$\gamma(^{51}Cr)$ (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.[#]	δ[@]	Comments
3267.2		2102	14 *6*	1164.87	9/2$^-$			
3345.7		1343	31 *6*	2003.1	5/2$^-$			
		1788	69 *6*	1557.14	7/2$^-$			
3350.9	3/2$^-$,5/2$^-$,7/2$^-$	1451	33 *6*	1899.0	3/2$^-$			
		1792	35 *6*	1557.14	7/2$^-$			
		2001	32 *6*	1352.59	5/2$^-$			
3447.9	13/2$^-$	1192.0[d] *8*	100[d]	2255.8	15/2$^-$	M1(+E2)[a]	+0.03[a] *3*	E_γ: 1193γ is seen by 1980Ka10 in coincidence with both the 775 and 905γ's, and the coincidence intensities cannot be accounted for by introducing a 2385-2255 transition since such a transition would have B(M1)(W.u.) and/or B(E2)(W.u.) greatly exceeding RUL. $\gamma(\theta)$: A_2=−0.174 *21*, A_4=−0.073 *27* (1973Sa12).
3578.8	(11/2,13/2,15/2)	1192.0[d] *8*	100[d]	2385.7	13/2$^-$			E_γ: see also note of 1129.0γ in 3448 level.
3771.1	1/2$^-$,3/2$^-$	2995	31 *6*	776.9	(1/2)$^-$			
		3021	69 *6*	749.19	3/2$^-$			
3830.7	(7/2,9/2,11/2)$^-$	2274	66 *7*	1557.14	7/2$^-$			
		3830	34 *7*	0.0	7/2$^-$			
3871.0		2706	100	1164.87	9/2$^-$			
3900.1	(5/2$^+$)	2001	7 *6*	1899.0	3/2$^-$			
		3900	93 *6*	0.0	7/2$^-$			
3927.2	(5/2$^+$)	3927[&] *2*	100	0.0	7/2$^-$			
3934.0		2769	100	1164.87	9/2$^-$			
3953.2	(5/2$^+$)	3202	35 *5*	749.19	3/2$^-$			
		3955	65 *5*	0.0	7/2$^-$			
3977.4	3/2$^+$,5/2$^+$	2419	18 *9*	1557.14	7/2$^-$			
		2624	52 *10*	1352.59	5/2$^-$			
		3230	30 *6*	749.19	3/2$^-$			
3985.3	(5/2$^+$)	983	31 *8*	3002.5	5/2$^-$			
		1982	16 *6*	2003.1	5/2$^-$			
		2428	9 *4*	1557.14	7/2$^-$			
		3985	44 *8*	0.0	7/2$^-$			
4005.6	5/2$^-$,7/2$^-$	2001		2003.1	5/2$^-$			
		2108		1899.0	3/2$^-$			
4017.2	(3/2$^-$,5/2,7/2$^-$)	3267		749.19	3/2$^-$			
		4018[&]		0.0	7/2$^-$			
4030		3281	100	749.19	3/2$^-$			
4056		2156	32 *12*	1899.0	3/2$^-$			
		2703	68 *12*	1352.59	5/2$^-$			
4071.2	5/2$^+$,7/2$^+$	2513		1557.14	7/2$^-$			
		3321		749.19	3/2$^-$			
		4073		0.0	7/2$^-$			
4107.3		1105	41 *12*	3002.5	5/2$^-$			
		2942	59 *12*	1164.87	9/2$^-$			
4111.3		1350		2762.3	1/2$^+$			
		2109		2003.1	5/2$^-$			
		3360		749.19	3/2$^-$			
4120.2		2117	100	2003.1	5/2$^-$			

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^{48}Ti(α,nγ) 1980Ka10,1973Sa12,1973Sz01 (continued)

$\gamma(^{51}Cr)$ (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π
4136.5		1373	15 *13*	2762.3	$1/2^+$	4189.2	$5/2^+,7/2^+$	4189	100	0.0	$7/2^-$
		2785	85 *13*	1352.59	$5/2^-$	4239.2		4239	100	0.0	$7/2^-$
4161.6		2603	38 *10*	1557.14	$7/2^-$	4254.2		4254	100	0.0	$7/2^-$
		2998	62 *10*	1164.87	$9/2^-$	4354.3	$(1/2^-,3/2^-)$	1592	100	2762.3	$1/2^+$
4182.0		3017	100	1164.87	$9/2^-$	4405.4		1643	100	2762.3	$1/2^+$

† Values with uncertainties are from 1973Sa12. Other values are deduced from the E(level) differences. Values given to the nearest keV without uncertainties are given by 1980Ka10.
‡ % photon branching from each level (1978Ka32,1980Ka10).
# From $\gamma(\theta)$, γ(pol) and yield functions in 1973Sa12, except as noted.
@ From $\gamma(\theta)$ and γ(pol) analyses (1980Ka10).
& From 1973Sz01.
a From 1973Sa12.
b From $\gamma(\theta)$, γ(pol) and comparison to RUL in 1978Ka32.
c From 1980Ka10. Value given in text.
d Multiply placed with intensity suitably divided.

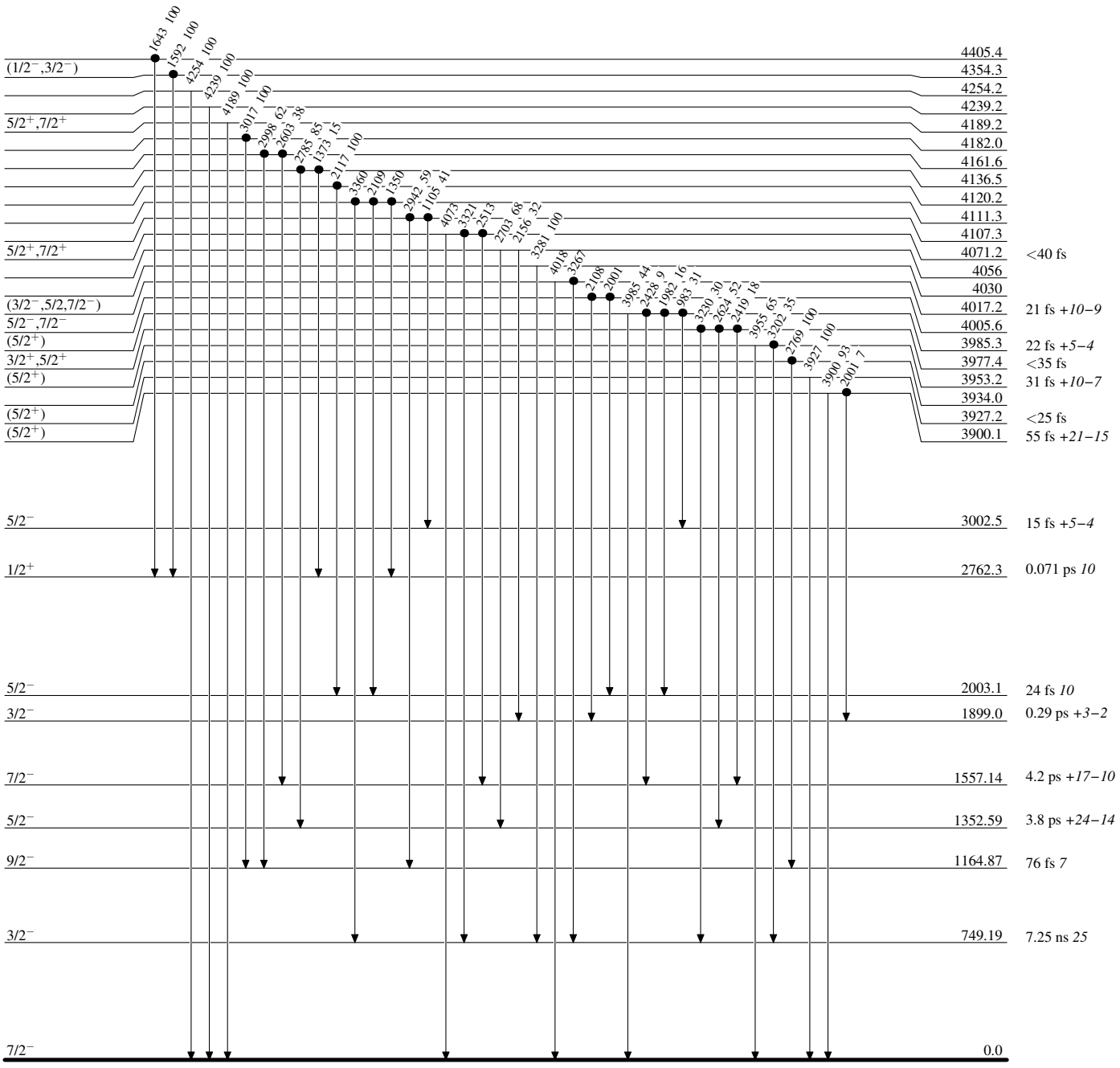
^{48}Ti(α,nγ) **1980Ka10,1973Sa12,1973Sz01**

Legend

Level Scheme

Intensities: % photon branching from each level

● Coincidence



$^{51}_{24}Cr_{27}$

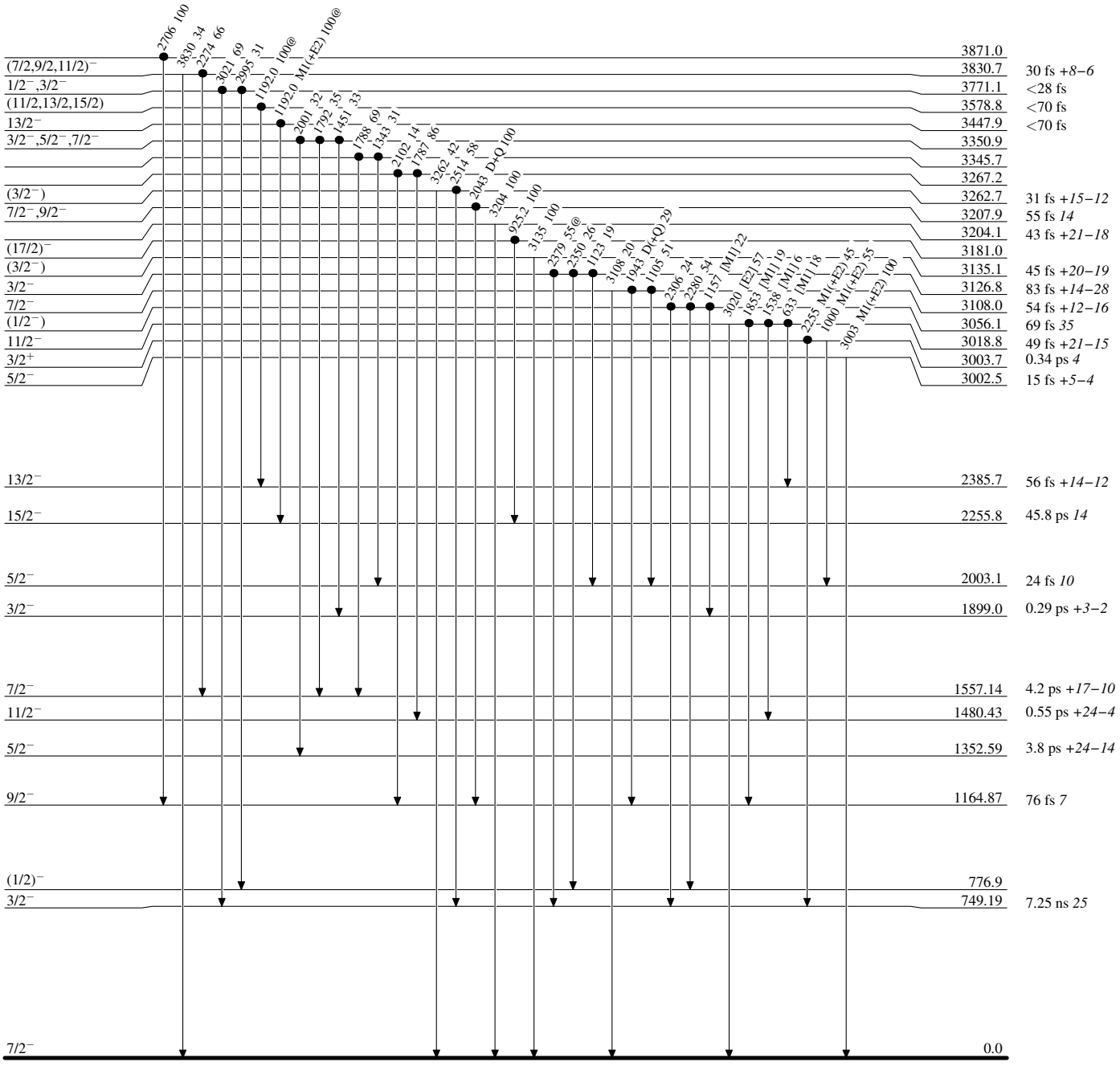
^{48}Ti(α,nγ) 1980Ka10,1973Sa12,1973Sz01

Legend

Level Scheme (continued)

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

● Coincidence



$^{51}_{24}Cr_{27}$

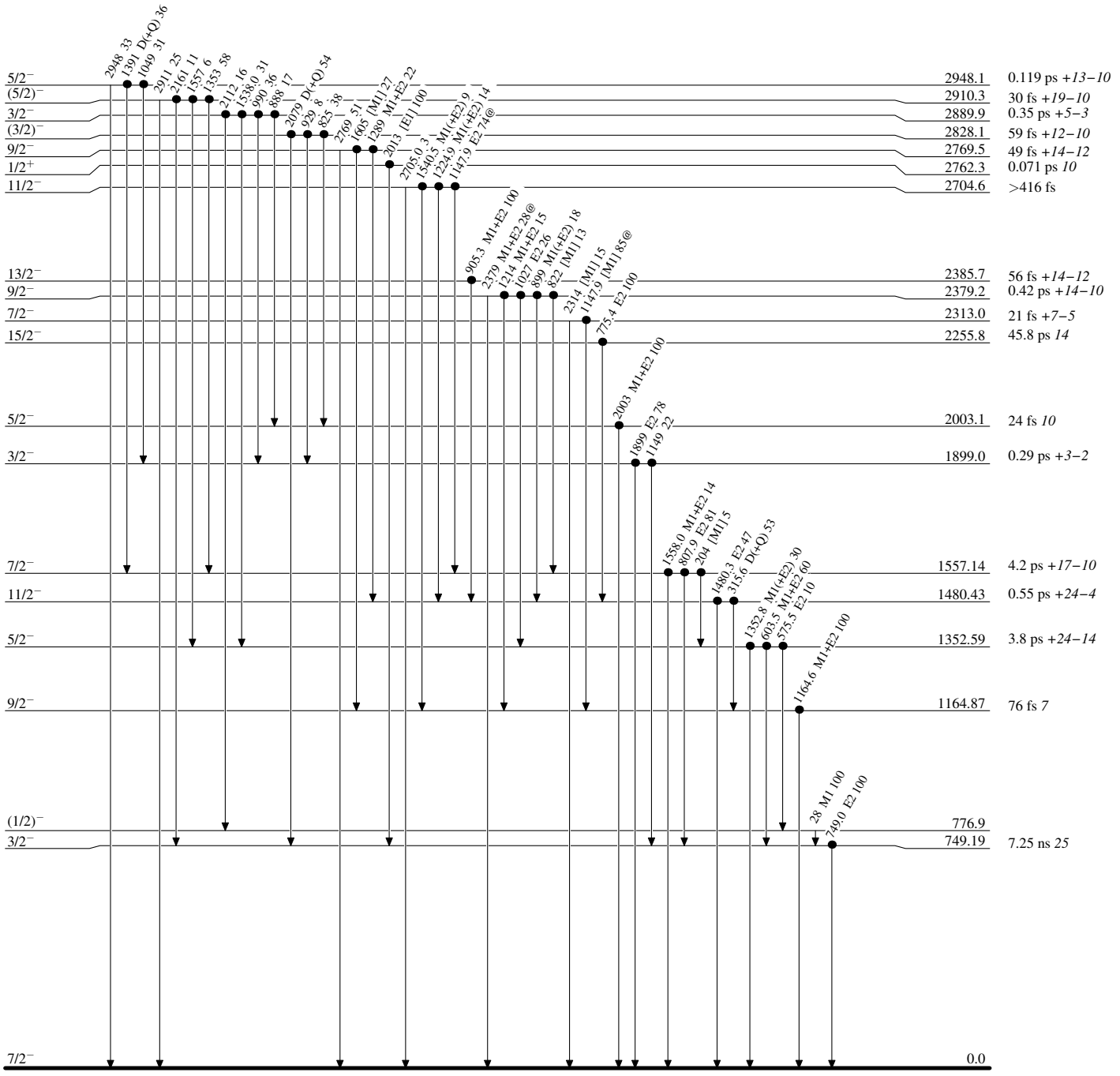
^{48}Ti(α,nγ) 1980Ka10,1973Sa12,1973Sz01

Legend

Level Scheme (continued)

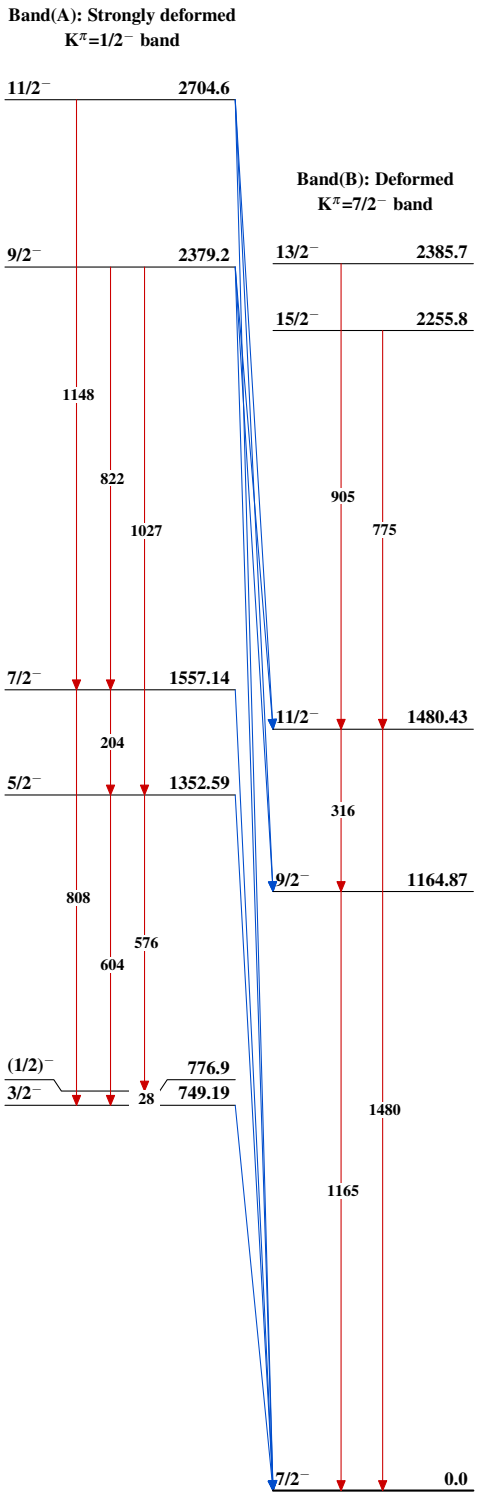
Intensities: % photon branching from each level
@ Multiply placed: intensity suitably divided

● Coincidence



$^{51}_{24}Cr_{27}$

^{48}Ti(α,nγ) 1980Ka10,1973Sa12,1973Sz01



$^{51}_{24}Cr_{27}$