^{50}Cr(p,p′γ) 1972Ra14,1972As01,1968Mo07

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen and Balraj Singh	NDS 157, 1 (2019)	15-Apr-2019

1972As01: E(p)=7 MeV beam from the University of Pennsylvania Tandem Van de Graaff. Measured Eγ, Iγ, γ(t) (DSAM), and γ(θ=0°, 90°, 160°) with a Ge(Li) detector. Deduced levels, $T_{1/2}$.

1972Ra14: E(p)=8.4 MeV beam from the Oak Ridge Tandem Van de Graaff. Measured Eγ, Iγ at θ=90° with a Ge(Li) detector. Deduced levels.

1968Mo07: E(p)=6.33-6.45 MeV from the 12-MeV tandem Van de Graaff at Liverpool University. Measured pγ(θ) with a annular Si for p (FWHM=50 keV) at θ=170° and a NaI for γ rays (θ=0°−90°, 10° steps). Deduced levels, J^π, γ-ray multipolarities. See also 1966Tw01 and 1964Tw01 from the same lab, where selected levels were studied.

Others:

1976GiZW (meeting abstract): E=9 MeV. Measured pγ-coin.

1971Sw08: E=12.0 MeV. Measured Eγ, σ(θ), analyzed the first 2^+ state, and deduced spin-flip probability.

1971Ne05: E<4 MeV. Measured Eγ, γ(θ), σ(θ).

1966Tw01: E=6.4-6.8 MeV. Measured Eγ, Iγ, γγ-coin, γγ(θ), deduced levels, J^π, mixing ratios. A total of 15 excited states up to 4080 were investigated using NaI(Tl) detectors. See more detailed 1968Mo07 paper from the same lab.

1964Tw01: E=5.8-10.2 MeV. Measured Eγ, Iγ, γγ-coin, deduced levels, J^π. A total of 20 excited states up to 4670 were investigated using NaI(Tl) detectors. See more detailed 1968Mo07 paper from the same lab.

^{50}Cr Levels

E(level)[†]	J^π	$T_{1/2}$[‡]	S	Comments
0.0	0^+			
783.31 *18*	2^+[&]		1.14	
1881.43 *25*	4^+[&]			
2924.6 *4*	2^+[#]	9.4 fs *14*	0.034	$T_{1/2}$: other: 10.4 fs *+42−35* from centroid shift (1972As01).
3161.3 *4*	2^+[#]	10.9 fs *16*	0.114	$T_{1/2}$: other: 10.4 fs *+42−35* from centroid shift (1972As01).
3164.1 *6*	6^+			
3324.3 *6*	4[#]	97 fs *25*	0.032	$T_{1/2}$: other: 101 fs *+38−36* from centroid shift (1972As01).
3594.7 *3*	2,3,4[a]	30 fs *5*		$T_{1/2}$: other: 39 fs *+15−13* from centroid shift (1972As01).
3611.4 *4*	≥4[a]	6 fs *4*	0.143	$T_{1/2}$: assuming 1730γ assignment is correct. Other: 6.2 fs *+56−42* from centroid shift (1972As01).
3629.5 *4*	1^+[#]	5.2 fs *25*		J^π: from σ(θ) (1989Wi13). $T_{1/2}$: other: 4.9 fs *+28−22* from centroid shift (1972As01).
3698.3 *5*	$1^+,2^+,3^+$[b]	12.8 fs *18*	0.054	J^π: 2^+ in Adopted Levels; possible 3698γ to 0^+ does not allow 3^+. $T_{1/2}$: other: 15 fs *+7−6* from centroid shift (1972As01).
3792.1 *6*	5[@]	>73 fs		$T_{1/2}$: from DSAM using centroid shift in 1972As01.
3826.1 *21*				
3844.6 *4*		0.22 ps *6*		$T_{1/2}$: other: >0.3 ps from centroid shift (1972As01).
3875.2 *5*				
3895.3 *6*	(1,2)[@]	24 ps *+14−10*	0.24	$T_{1/2}$: from DSAM using centroid shift in 1972As01. J^π: 0^+ in Adopted Levels.
3937.3 *4*		2.2 fs *10*		$T_{1/2}$: other: <7 fs from centroid shift (1972As01).
4040	0^+			E(level): from 1989Wi13; J^π from σ(θ).
4051.7 *5*		0.56 ps *11*	0.643	$T_{1/2}$: other: 0.28 fs *+29−15* from centroid shift (1972As01).
4070.2 *7*		6.5 fs *17*		$T_{1/2}$: other: <8 fs from centroid shift (1972As01). J^π: 0^+ in Adopted Levels.
4130.0 *5*		0.18 ps *6*		$T_{1/2}$: other: 0.10 fs *+22−6* from centroid shift (1972As01).
4193.6 *7*	(2^+)		0.119	J^π: from σ(θ) (1989Wi13).
4523.9 *7*				
4546.4 *8*			0.100	
4654.6 *7*				

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^{50}Cr(p,p′γ) 1972Ra14,1972As01,1968Mo07 (continued)

^{50}Cr Levels (continued)

† From least-squares fit to Eγ data.
‡ From 1972As01 using DSAM, from shape fitting method. Values from centroid shift method are also available in 1972As01, in good agreement but less precise.
# From pγ(θ) and multipolarity of deexciting γ (1968Mo07) together with triple correlation measurements (1966Tw01).
@ From pγ(θ) (1968Mo07) together with triple correlation measurements (1966Tw01).
& From Adopted Levels.
a From DWBA and feeding to levels with J^π known from previous studies (1972Ra14).
b J from pγ(θ); π=+ from M1+E2 γ to 2^+ (1968Mo07,1966Tw01).

γ(^{50}Cr)

E_γ †	I_γ †	E_i(level)	J_i^π	E_f	J_f^π	Mult. @	Comments
x394 2	≈0.2						
x423 2	≈0.3						
441bc 2	≈0.2b	4051.7		3611.4	≥4		
441bc 2	≈0.2b	4070.2		3629.5	1^+		
449bc 2	≈0.3b	3611.4	≥4	3164.1	6^+		
449bc 2	≈0.3b	3611.4	≥4	3161.3	2^+		
458bc 2	≈0.1b	4051.7		3594.7	2,3,4		
458bc 2	≈0.1b	4070.2		3611.4	≥4		This γ from 0^+ to a 3610, 4^+ level is unlikely, not included in Adopted Levels, Gammas dataset.
467.7 8	0.9 1	3792.1	5	3324.3	4	D+Q	A_2=+0.84 24, A_4=+0.38 17 for 468γ. %branching=56 5 (1968Mo07).
494bc 2	≈0.2b	4193.6	(2^+)	3698.3	1^+,2^+,3^+		
494bc 2	≈0.2b	4546.4		4051.7			
500 2	≈0.1	4130.0		3629.5	1^+		
550 2	≈0.2	3875.2		3324.3	4		
(628‡)	≤0.1‡	3792.1	5	3164.1	6^+		
662 2	≈0.2	3826.1		3164.1	6^+		
683.4 10	0.4 1	3844.6		3161.3	2^+		
(687‡)	≤0.2‡	3611.4	≥4	2924.6	2^+		
711.1 6	0.4 1	3875.2		3164.1	6^+		
732bc 2	≈0.2b	3895.3	(1,2)	3161.3	2^+		
732bc 2	≈0.2b	4523.9		3792.1	5		
783.4 2	100.0	783.31	2^+	0.0	0^+		E_γ: weighted average of 783.3 2 (1972Ra14) and 783.9 5 (1972As01).
890.6 5	1.8 3	4051.7		3161.3	2^+		
955 2	≈0.1	4654.6		3698.3	1^+,2^+,3^+		
x961.8 6	0.7 2						
1014.3 9	≈0.4	3937.3		2924.6	2^+		
(1043‡)	≤0.3‡	2924.6	2^+	1881.43	4^+		
1098.2 3	26.3 20	1881.43	4^+	783.31	2^+		E_γ: weighted average of 1098.0 2 (1972Ra14) and 1098.6 3 (1972As01).
1126.9 5	4.4 4	4051.7		2924.6	2^+		
(1146‡)	≤0.3‡	4070.2		2924.6	2^+		
1205.3 4	1.9 3	4130.0		2924.6	2^+		A_2=(0.0 19), A_4=0.0 7; A_2'=−0.45 51, A_4'=0.00 34 for 1205γ (1972As01). E_γ: weighted average of 1205.2 4 (1972Ra14) and 1205.5 7 (1972As01).
1268.3 8	0.7 1	4193.6	(2^+)	2924.6	2^+		
(1280‡)	≤0.3‡	3161.3	2^+	1881.43	4^+		

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^{50}Cr(p,p′γ) 1972Ra14,1972As01,1968Mo07 (continued)

γ(^{50}Cr) (continued)

E_γ †	I_γ †	E_i(level)	J_i^π	E_f	J_f^π	Mult. @	δ a	Comments
1282.7 *7*	1.3 *1*	3164.1	6^+	1881.43	4^+			
1363 bc *2*	≈0.5 b	4523.9		3164.1	6^+			
1363 bc *2*	≈0.5 b	4523.9		3161.3	2^+			
1384.8 *15*	≈0.6	4546.4		3161.3	2^+			
1442.7 *7*	5.3 *8*	3324.3	4	1881.43	4^+	D(+Q)	−0.02 *+16−52*	A_2=+0.42 *8*, A_4=+0.07 *9*; A_2=+0.37 *5*, A_4=+0.09 *6* for 1443γ (1968Mo07). A_2=+0.37 *11*, A_4=+0.11 *15*; A_2=+0.24 *8*, A_4=0 for 1098γ (1968Mo07). A_2=+0.29 *11*, A_4=−0.10 *15*; A_2=+0.34 *6*, A_4=0 for 783γ (1968Mo07). A_2=(+0.1 *14*), A_4=+0.3 *4*; A_2'=−0.43 *12*, A_4'=+0.09 *7* for 1443γ (1972As01). E_γ: unweighted average of 1443.3 *2* (1972Ra14) and 1442.1 *4* (1972As01).
1493 c *2*	≈0.2	4654.6		3161.3	2^+			
1599 *2*	≈0.2	4523.9		2924.6	2^+			
1622 *2*	≈0.4	4546.4		2924.6	2^+			
x1682 *2*	≈0.2							
1713.2 *3*	2.1 *3*	3594.7	2,3,4	1881.43	4^+			E_γ: weighted average of 1713.2 *3* (1972Ra14) and 1712.8 *9* (1972As01).
1729.9 b *3*	3.6 b *4*	3611.4	≥4	1881.43	4^+			A_2=0.0 *7*, A_4=0.0 *1*; A_2'=0.0 *6*, A_4'=0.0 *3* for 1730γ (1972As01). E_γ: weighted average of 1730.0 *3* (1972Ra14) and 1729 *1* (1972As01).
1730.0 bc *3*	3.6 b *4*	4654.6		2924.6	2^+			
(1817‡&)	≤0.3‡	3698.3	$1^+,2^+,3^+$	1881.43	4^+			
1910.7 *8*	1.2 *2*	3792.1	5	1881.43	4^+	D+Q	−0.47 *16*	A_2=+0.50 *8*, A_4=+0.03 *9* for 1911γ (1968Mo07). A_2=+0.24 *11*, A_4=0 for 1443γ (1968Mo07). A_2=+0.28 *8*, A_4=−0.14 *10* for 1098γ (1968Mo07). A_2=+0.43 *12*, A_4=0 for 783γ (1968Mo07). E_γ: weighted average of 1911.1 *8* (1972Ra14) and 1910 *1* (1972As01). %branching=44 *5* (1968Mo07).
1963.3 *4*	1.8 *2*	3844.6		1881.43	4^+			A_2=−0.2 *2*, A_4=+0.01 *7*; A_2'=(0.0), A_4'=(0.0) for 1963γ (1972As01). E_γ: weighted average of 1962.9 *4* (1972Ra14) and 1963.6 *4* (1972As01). %branching=65 *15* (1968Mo07).
1993.8 *6*	0.6 *2*	3875.2		1881.43	4^+			
(2014‡&)	≤0.8‡	3895.3	(1,2)	1881.43	4^+			
x2018 *2*	0.8 *2*							
2055.5 *4*	2.4 *4*	3937.3		1881.43	4^+			A_2=−0.03 *2*, A_4=+0.01 *1*; A_2'=(0.0 *15*), A_4'=+0.1 *4* for 2056γ (1972As01). E_γ: weighted average of 2055.2 *10* (1972Ra14) and 2055.5 *4* (1972As01). %branching=55 *10* (1968Mo07).

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^{50}Cr(p,p′γ) 1972Ra14,1972As01,1968Mo07 (continued)

γ(^{50}Cr) (continued)

E_γ[†]	I_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[@]	δ[a]	Comments
2141.5 *4*	16.6 *8*	2924.6	2+	783.31	2+	D(+Q)	−0.03 *6*	A_2=+0.36 *3*, A_4=−0.05 *3*; A_2=+0.37 *1*, A_4=−0.01 *1* for 2142γ (1968Mo07). A_2=+0.29 *7*, A_4=+0.12 *9*; A_2=+0.20 *5*, A_4=−0.04 *9* for 783γ (1968Mo07). A_2=+0.06 *2*, A_4=+0.05 *3*; A_2'=+0.29 *5*, A_4'=−0.20 *4* for 2142γ (1972As01). E_γ: unweighted average of 2141.1 *3* (1972Ra14) and 2141.8 *1* (1972As01). %branching=97 *1* (1968Mo07).
(2170‡)	≤0.5‡	4051.7		1881.43	4+			
(2313‡)	≤0.4‡	4193.6	(2+)	1881.43	4+			
2378.3 *5*	10.5 *12*	3161.3	2+	783.31	2+	M1+E2	+0.24 *9*	A_2=+0.13 *7*, A_4=−0.06 *8*; A_2=+0.09 *4*, A_4=+0.05 *6* for 2378γ (1968Mo07). A_2=+0.34 *4*, A_4=+0.29 *6*; A_2=+0.14 *10*, A_4=+0.08 *15* for 783γ (1968Mo07). A_2=+0.04 *2*, A_4=+0.02 *1*; A_2'=−0.58 *10*, A_4'=+0.65 *12* for 2378γ (1972As01). E_γ: unweighted average of 2377.8 *3* (1972Ra14) and 2378.8 *4* (1972As01). %branching=91 *2* (1968Mo07).
(2541‡)	≤0.5‡	3324.3	4	783.31	2+			
x2603 *4*	≈2							
(2642‡)	≤0.5‡	4523.9		1881.43	4+			
(2665‡)	≤0.5‡	4546.4		1881.43	4+			
(2775‡)	≤0.2‡	4654.6		1881.43	4+			
x2800 *2*	≈0.4							
2811.3 *3*	3.0 *3*	3594.7	2,3,4	783.31	2+			A_2=(+1.6 *13*), A_4=+0.4 *3*; A_2'=−0.7 *2*, A_4'=+0.02 *3* for 2811γ (1972As01). E_γ: weighted average of 2811.2 *3* (1972Ra14) and 2812.1 *8* (1972As01).
(2828‡)	≤0.6‡	3611.4	≥4	783.31	2+			
2846.1 *6*	1.8 *8*	3629.5	1+	783.31	2+			E_γ: weighted average of 2846.3 *8* (1972Ra14) and 2846.0 *6* (1972As01). %branching=20 *10* (1968Mo07).
2914.8 *5*	5.8 *4*	3698.3	1+,2+,3+	783.31	2+	M1+E2	+0.71 *23*	A_2=−0.24 *7*, A_4=+0.08 *11* for 2915γ (1968Mo07). A_2=+0.24 *7*, A_4=+0.22 *9* for 783γ (1968Mo07). A_2=−0.01 *6*, A_4=+0.05 *1*; A_2'=+0.06 *13*, A_4'=−0.07 *7* for 2915γ (1972As01). E_γ: weighted average of 2914.3 *6* (1972Ra14) and 2915.1 *5* (1972As01).
2924 *2*	1.5 *4*	2924.6	2+	0.0	0+	E2		%branching=3 *1* (1968Mo07).
3060.9 *6*	0.9 *2*	3844.6		783.31	2+			%branching=35 *15* (1968Mo07).
(3092‡)	≤0.4‡	3875.2		783.31	2+			
3112.0 *10*	3.8 *13*	3895.3	(1,2)	783.31	2+	(D+Q)		A_2=+0.04 *3*, A_4=−0.08 *4* for 3112γ (1968Mo07). A_2=+0.14 *5*, A_4=0 for 783γ (1968Mo07). E_γ: weighted average of 3111.9 *15* (1972Ra14) and 3112 *1* (1972As01). δ: −0.09 *29* for J=1 or +0.34 *13* for J=2.
3153.7 *20*	≈2.0	3937.3		783.31	2+			%branching=45 *10* (1968Mo07).
(3161‡)	≤0.8‡	3161.3	2+	0.0	0+			%branching=9 *2* (1968Mo07).
3267.4 *14*	2.0 *7*	4051.7		783.31	2+			A_2=+0.08 *5*, A_4=0 for 3267γ (1968Mo07).

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^{50}Cr(p,p′γ) 1972Ra14,1972As01,1968Mo07 (continued)

γ(^{50}Cr) (continued)

E_γ[†]	I_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[@]	Comments
							A_2=+0.12 *5*, A_4=0 for 783γ (1968Mo07). A_2=0.0 *8*, A_4=+0.02 *12*; A_2'=(0.0 *29*), A_4'=(+0.4 *9*) for 3267γ (1972As01). E_γ: unweighted average of 3268.8 *8* (1972Ra14) and 3266 *1* (1972As01).
3284.8 *22*	2.8 *7*	4070.2		783.31	2^+		A_2=+0.01 *3*, A_4=0.00 *1*; A_2'=(0.0 *31*), A_4'=0.00 *13* for 3285γ (1972As01). E_γ: unweighted average of 3287 *2* (1972Ra14) and 3282.6 *11* (1972As01).
(3347[‡])	≤0.8[‡]	4130.0		783.31	2^+		
3410.1 *20*	0.8 *2*	4193.6	(2^+)	783.31	2^+		
[x]3453[#c] *3*	≈0.5						
3629.3 *5*	3.6 *10*	3629.5	1^+	0.0	0^+	D	A_2=−0.48 *7*, A_4=+0.08 *8* for 3629γ (1968Mo07). A_2=+0.04 *6*, A_4=+0.02 *1*; A_2'=+0.14 *32*, A_4'=−0.10 *16* for 3629γ (1972As01). E_γ: from 1972As01. Other: 3629 *2* (1972Ra14). %branching=80 *10* (1968Mo07).
(3698[‡&])	≤0.4[‡]	3698.3	$1^+,2^+,3^+$	0.0	0^+		
[x]3722[#c] *3*	≈0.4						
3740.5 *20*	1.3 *3*	4523.9		783.31	2^+		E_γ: indicated as unplaced Eγ in table 2 of 1972Ra14 but placed in authors' level-scheme fig. 6.
3763 *3*	0.5 *2*	4546.4		783.31	2^+		
(3844[‡])	≤0.5[‡]	3844.6		0.0	0^+		
3870 *2*	1.1 *3*	4654.6		783.31	2^+		
(3895[‡])	≤0.6[‡]	3895.3	(1,2)	0.0	0^+		
(3937[‡])	≤0.6[‡]	3937.3		0.0	0^+		
(4070[‡])	≤0.6[‡]	4070.2		0.0	0^+		
4130[c] *3*	≈5.0	4130.0		0.0	0^+		
4193[c] *3*	≈2.0	4193.6	(2^+)	0.0	0^+		
(4524[‡])	≤0.5[‡]	4523.9		0.0	0^+		
(4653[‡])	≤1.0[‡]	4654.6		0.0	0^+		

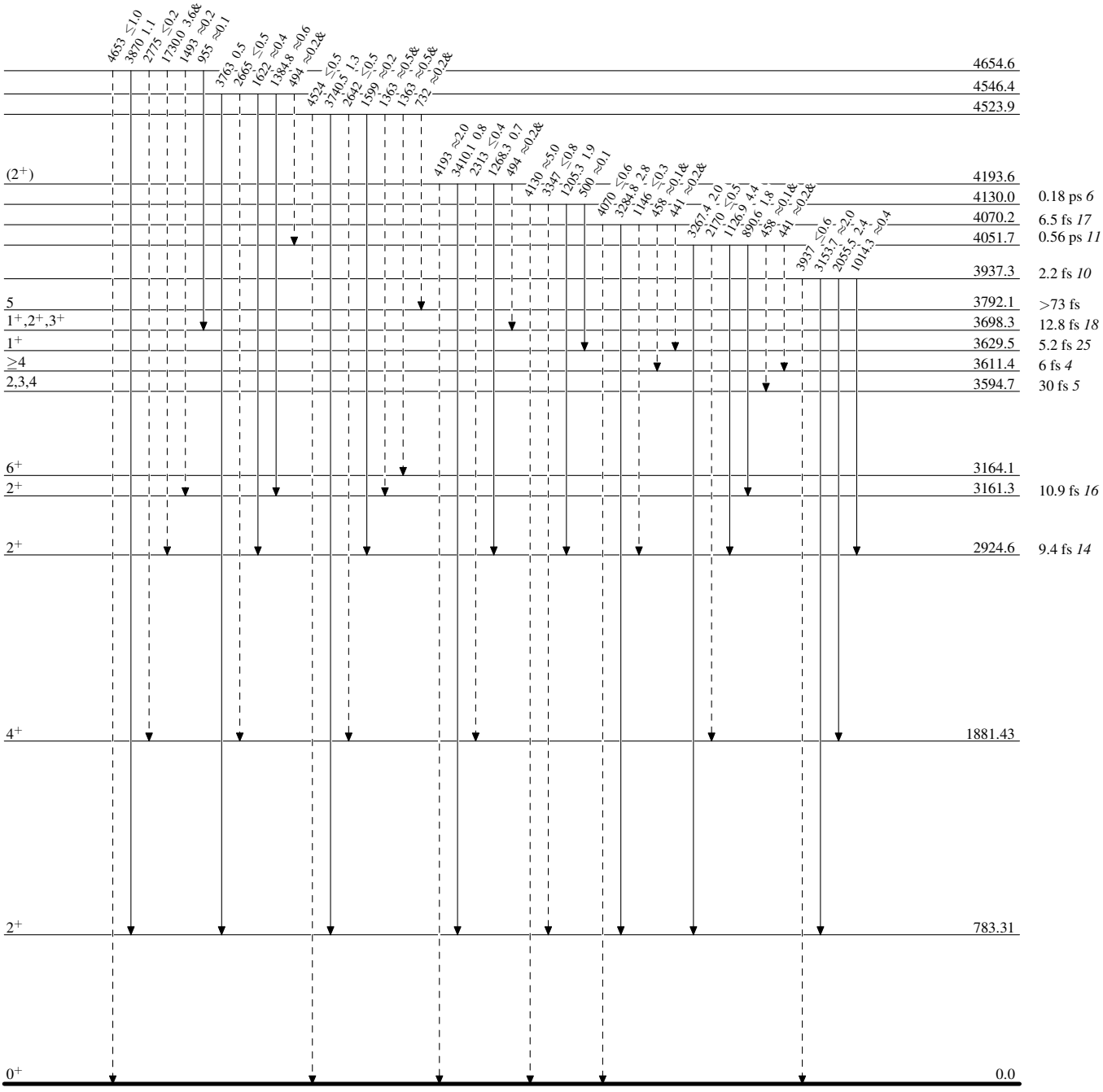
[†] From 1972Ra14, except as noted. From least-squares analysis, ΔE(γ) appear to be overestimated. Iγ at θ=90° relative to the beam.
[‡] Possible but unobserved transition. Iγ from branching ratios in fig. 6 of 1972Ra14 and Iγ of strongest transition from the state. Only those transitions suggested by 1972Ra14 which are consistent with the current Adopted spins and parities are included.
[#] May be an escape peak of a higher-energy γ ray (1972Ra14).
[@] From pγ(θ) in 1968Mo07 and comparison to RUL (evaluators) where available, except as noted.
[&] This γ is not included in the Adopted Levels, Gammas dataset.
[a] From pγ(θ) in 1968Mo07.
[b] Multiply placed with undivided intensity.
[c] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

^{50}Cr(p,p′γ) 1972Ra14,1972As01,1968Mo07

Level Scheme

Intensities: Relative I_γ
& Multiply placed: undivided intensity given

Legend
$I_\gamma < 2\% \times I_\gamma^{max}$
$I_\gamma < 10\% \times I_\gamma^{max}$
$I_\gamma > 10\% \times I_\gamma^{max}$
γ Decay (Uncertain)



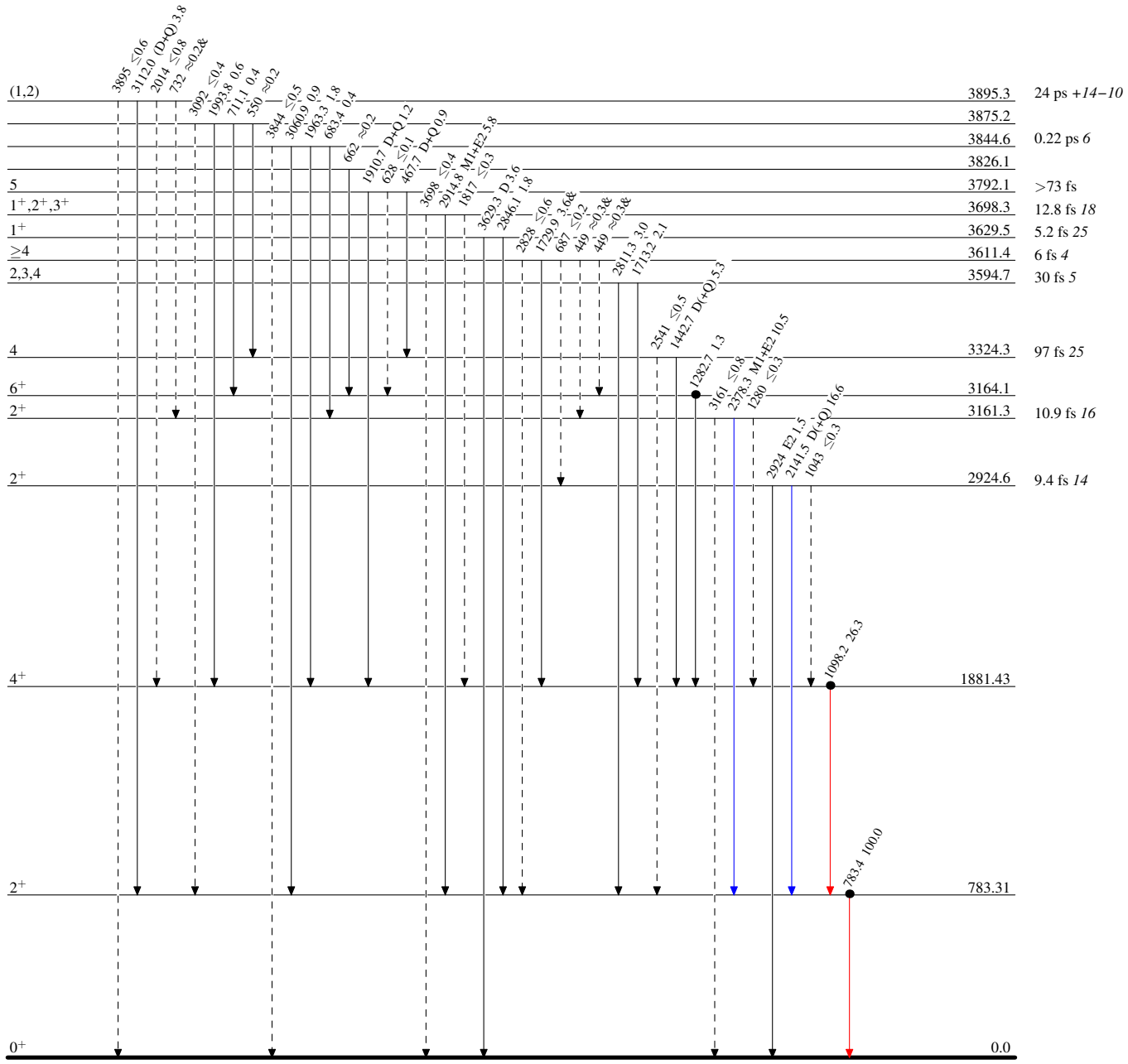
$^{50}_{24}Cr_{26}$

^{50}Cr(p,p′γ) 1972Ra14,1972As01,1968Mo07

Level Scheme (continued)

Intensities: Relative I_γ
& Multiply placed: undivided intensity given

Legend
$I_\gamma < 2\% \times I_\gamma^{max}$
$I_\gamma < 10\% \times I_\gamma^{max}$
$I_\gamma > 10\% \times I_\gamma^{max}$
γ Decay (Uncertain)
Coincidence



$^{50}_{24}Cr_{26}$