^{205}Tl(α,4nγ) 1989By03,1983Hu15,1977Br05

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	F. G. Kondev	NDS 166, 1 (2020)	20-Apr-2020

1989By03: E(α)=52 MeV (γγ coin), E(α)=50 MeV (γ(θ)), E(α)=41.5-55 MeV (Excitation functions); Target: 99.6% enriched ^{205}Tl; Detectors: five Compton suppressed HPGE detectors (γγ coin and polarization) and a single HPGE detector located at five angles between 35° and 145° (γ(θ)); Measured: Eγ, Iγ, γ singles, γγ coin, γ(θ), γ linear polarization; Deduced: level scheme, J$^{\pi}$, transition multipolarities.

1983Hu15: E(α)=50 MeV; Target: 97% enriched with ^{205}Tl and with thickness between 0.6 and 6.0 mg/cm^2; Detectors: HPGE detectors, Si(Li) electron spectrometer; Measured: Eγ, Iγ, γγ coin, γ(θ), ce, ce-ce; coin, $T_{1/2}$; Deduced: level scheme, J$^{\pi}$, transition multipolarities and strength, electron conversion coefficients and subshell ratios.

1977Br05: E(α)=47.9 and 53.2 MeV. ^{203}Tl(α,2nγ)^{205}Bi at E(α)=30.9 MeV; Target: 97% enriched targets; Detectors: Ge(Li), iron-free orange ce spectrometer; Measured: Eγ, Iγ, γ singles, γγ, γ(θ), γ(t), ce; Deduced: level scheme, J$^{\pi}$, transition multipolarities and strength, electron conversion coefficients.

Others: 1982Hu07, 1978Hu02, 2013Bo18.

^{205}Bi Levels

E(level)[†]	J$^{\pi}$[‡]	$T_{1/2}$	Comments
0[#]	9/2$^-$	14.91 d *7*	J$^{\pi}$,$T_{1/2}$: From Adopted Levels.
796.00[@] *16*	11/2$^-$		
881.42[@] *15*	13/2$^-$		
1110.09[a] *14*	13/2$^-$		
1167.80[&] *15*	15/2$^-$		
1310.1 *3*	(15/2$^-$,13/2$^+$)		
1343.98[&] *18*	17/2$^-$		
1572.19[a] *20*	17/2$^-$		
1701.23 *19*	15/2$^-$		
1837.9 *3*	15/2$^-$		
2041.29 *18*	17/2$^+$		
2064.2[b] *3*	21/2$^+$	80 ns *15*	$T_{1/2}$: From 1978Hu02 using a two isomers fit to 176ce(K)-γ(t) spectra. μ: μ=2.70 *4* and 2.741 *11* from the measured g-factors of g=0.257 *4* (1982Hu07) and g=0.261 *1* (1981BeYR), respectively. Gamma rays deexciting the 17/2$^+$ state were used in conjunction with the perturbed angular distribution method, thus both the 21/2$^+$ and the 25/2$^+$ isomers contribute to the measured g-factor. The expected difference between the two g-factors is too small to be distinguished in the measurements (1981BeYR,1982Hu07), e.g. g-factor(21/2$^+$)=0.30 *2* and g-factor(25/2$^+$)=0.26 *1* (1982Hu07).
2138.5[b] *6*	25/2$^+$	220 ns *25*	$T_{1/2}$: From 1978Hu02 using a two isomers fit to 176ce(K)-g(t) spectra. μ: μ=3.21 *5* and 3.263 *12* from the measured g-factors of g=0.257 *4* (1982Hu07) and g=0.261 *1* (1981BeYR), respectively. Gamma rays deexciting the 17/2$^+$ state were used in conjunction with the perturbed angular distribution method, thus both the 21/2$^+$ and the 25/2$^+$ isomers contribute to the measured g-factor. The expected difference between the two g-factors is too small to be distinguished in the measurements (1981BeYR,1982Hu07), e.g. g-factor(21/2$^+$)=0.30 *2* and g-factor(25/2$^+$)=0.26 *1* (1982Hu07).
2779.8 *6*	27/2$^+$		
3197.2[b] *6*	27/2$^+$		
3200.5 *7*	29/2$^+$		
3379.3[c] *6*	29/2$^-$	2.54 ns *6*	$T_{1/2}$: From ce(K)(t) for 600γ and 641γ in 1977Br05. Other: 2.45 ns in 1983Hu15.
3895.4[c] *7*	31/2$^-$		
4019.0[d] *7*	33/2$^-$		
4171.3[d] *7*	35/2$^-$		

Continued on next page (footnotes at end of table)

^{205}Tl(α,4nγ) 1989By03,1983Hu15,1977Br05 (continued)

^{205}Bi Levels (continued)

E(level)[†]	J^{π}[‡]	E(level)[†]	J^{π}[‡]	E(level)[†]	J^{π}[‡]	E(level)[†]
4181.0 *7*	$31/2^+$	4957.5[f] *7*	$33/2^+$	5484.3[g] *7*	$37/2^+$	5941.0 *7*
4649.9[e] *7*	$35/2^-$	5163.5[f] *7*	$35/2^+$	5580.5? *5*		5948
4694.9[e] *7*	$37/2^-$	5392.6 *7*		5875.4 *8*		6452?
4933.7[d] *7*	$37/2^-$	5406.0 *7*	$39/2^{(-)}$	5930.5[g] *7*	$(39/2^+)$	6718.4 *13*

† From least-squares fit to Eγ.

‡ From 1989By03, based on the deduced γ-ray transition multipolarities and multiple γ-ray decay branches, unless otherwise stated.

\# configuration=$\pi(h_{9/2}^{+1})$.

@ configuration=$\pi(h_{9/2}^{+1})\otimes 2^+$.

& configuration=$\pi(h_{9/2}^{+1})\otimes 4^+$.

a configuration=$\pi(h_{9/2}^{+1})\nu(p_{1/2}^{-1},f_{5/2}^{-1})$.

b configuration=$\pi(h_{9/2}^{+1})\nu(f_{5/2}^{-1},i_{13/2}^{-1})$.

c configuration=$\pi(h_{9/2}^{+1})\nu(i_{13/2}^{-2})$.

d configuration=$\pi(h_{9/2}^{+1})\nu(p_{1/2}^{-1},f_{5/2}^{-1},i_{13/2}^{-2})$.

e configuration=$\pi(h_{9/2}^{+1})\nu(f_{5/2}^{-2},i_{13/2}^{-2})$.

f configuration=$\pi(h_{9/2}^{+1})\nu(p_{1/2}^{-2},i_{13/2}^{-2})$.

g configuration=$\pi(h_{9/2}^{+1})\nu(p_{1/2}^{-1},i_{13/2}^{-3})$.

γ(^{205}Bi)

E_γ[†]	I_γ[†]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	δ[@]	Comments
23.8 5		2064.2	$21/2^+$	2041.29	$17/2^+$	[E2]		
57.7[‡] 1	5.7[‡] 3	1167.80	$15/2^-$	1110.09	$13/2^-$	M1(+E2)	<0.14	Mult.: α(L3)/α(L1)<0.1 (1977Br05); (α(L1)+α(L2))/α(L3)>10 (1983Hu15).
74.3 5		2138.5	$25/2^+$	2064.2	$21/2^+$	E2		Mult.: (α(L1)+α(L2))/α(L3)=1.3 2 (1983Hu15).
77[a] 1		5484.3	$37/2^+$	5406.0	$39/2^{(-)}$			
85.3 5		881.42	$13/2^-$	796.00	$11/2^-$			
123.9 2	3.5 2	4019.0	$33/2^-$	3895.4	$31/2^-$	M1(+E2)	<0.3	Mult.: α(L3)/α(L1)<0.1 (1977Br05); A_2=−0.25 3, A_4=−0.04 4 (1989By03).
152.3 2	5.0 3	4171.3	$35/2^-$	4019.0	$33/2^-$	M1(+E2)	<0.6	Mult.: α(L3)/α(L1)<0.2 (1977Br05); A_2=−0.18 3, A_4=0.03 4 (1989By03).
176.1 2	29.2 15	1343.98	$17/2^-$	1167.80	$15/2^-$	M1+E2	0.120 21	Mult.: α(L3)/α(L1)=0.014 5; A_2=−0.25 3, A_4=0.004 42 (1977Br05); A_2=−0.20 1, A_4=0.02 2; A_2=−0.22 2, A_4=0.00 3 (1983Hu15).
181.7 2	3.2 2	3379.3	$29/2^-$	3197.2	$27/2^+$	(E1)		Mult.: A_2=−0.17 7, A_4=−0.01 10 (1989By03).
203.4 2	5.3 3	2041.29	$17/2^+$	1837.9	$15/2^-$	(E1)		Mult.: A_2=−0.20 3, A_4=−0.04 4(1989By03).
205.6 2	2.0 1	5163.5	$35/2^+$	4957.5	$33/2^+$	(M1)		Mult.: A_2=−0.31 8, A_4=−0.05 10 (1989By03).
228.2 2	2.4 1	1572.19	$17/2^-$	1343.98	$17/2^-$	(M1)		E_γ,I_γ: Unresolved doublet or multiplet (1989By03). Mult.: A_2=0.00 5, A_4=0.05 6 (1989By03).
229.1 2	2.7 1	5392.6		5163.5	$35/2^+$			A_2=0.03 5, A_4=0.06 6 (1989By03).
286.2 2	57.1 29	1167.80	$15/2^-$	881.42	$13/2^-$	M1(+E2)	<0.33	E_γ: The 286ce(K) line shows a delayed time component of $T_{1/2}$=405 ns 41 (1977Br05). Mult.: α(L3)/α(L1)<0.03; A_2=−0.28 2, A_4=0.007 22 (1977Br05); A_2=−0.27 1, A_4=0.00 2, P(90°)=−0.33 3 (1989By03); A_2=−0.28 2, A_4=0.00 2 (1983Hu15).
[x]306.6 2	≈1							
314.1 2	25.4 13	1110.09	$13/2^-$	796.00	$11/2^-$	M1		Mult.: α(K)exp=0.42 4; A_2=−0.29 3, A_4=−0.002 30 (1977Br05); A_2=−0.25 2, A_4=−0.01 3, P(90°)=−0.32 3 (1989By03); A_2=−0.28 2, A_4=−0.02 2 (1983Hu15).
320.5 2	2.0 1	5484.3	$37/2^+$	5163.5	$35/2^+$	M1		Mult.: A_2=−0.31 9, A_4=−0.06 13, P(90°)=−1.14 50 (1989By03).
340.0 2	4.70 24	2041.29	$17/2^+$	1701.23	$15/2^-$	(E1)		Mult.: A_2=−0.13 3, A_4=−0.04 4, P(90°)=0.59 11 (1989By03).
404.4 2	13.8 7	1572.19	$17/2^-$	1167.80	$15/2^-$	M1		Mult.: α(K)exp=0.20 2; A_2=−0.33 3, A_4=0.03 4 (1977Br05); A_2=−0.30 1, A_4=0.03 2, P(90°)=−0.12 2 (1989By03); A_2=−0.31 2, A_4=0.02 3 (1983Hu15).
[x]408.0 5	0.50 3							
416.7[&] 2	5.1[&] 3	3197.2	$27/2^+$	2779.8	$27/2^+$	M1		Mult.: A_2=−0.58 5, A_4=0.01 6, P(90°)=0.16 5 (1989By03).
416.7[&a] 5	5.1[&] 3	5580.5?		5163.5	$35/2^+$			
420.6 2	5.0 3	3200.5	$29/2^+$	2779.8	$27/2^+$	M1+E2		Mult.: A_2=−0.32 3, A_4=0.01 7, P(90°)=−0.20 5 (1989By03). The sign of δ is negative (figure 3 in 1989By03).
428.8 5	2.2 1	1310.1	$(15/2^-,13/2^+)$	881.42	$13/2^-$			A_2=0.29 7, A_4=0.04 8, P(90°)=0.32 16 (1989By03).
446.2 2	1.8 1	5930.5	$(39/2^+)$	5484.3	$37/2^+$	(M1)		Mult.: A_2=−0.29 7, A_4=−0.03 9, P(90°)=−0.28 30 (1989By03).
456.7 2	2.5 1	5941.0		5484.3	$37/2^+$			A_2=0.11 5, A_4=0.01 3, P(90°)=0.50 25 (1989By03).
[x]458.4 2	7.0 5							A_2=0.33 4, A_4=−0.02 5 (1989By03);

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γ(^{205}Bi) (continued)

E_γ[†]	I_γ[†]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	δ[@]	Comments
462.6[&] *2*	2.1[&] *1*	1343.98	17/2⁻	881.42	13/2⁻	(E2)		Mult.: A_2=0.04 *7*, A_4=−0.02 *9*, P(90°)=0.40 *18* (1989By03).
462.6[&a] *5*	2.1[&] *1*	5948		5484.3	37/2⁺			
469.1 *2*	15.2 *8*	2041.29	17/2⁺	1572.19	17/2⁻	E1		Mult.: α(K)exp=0.0116 *28*; A_2=0.25 *6*, A_4=0.02 *8* (1977Br05); A_2=0.34 *2*, A_4=−0.01 *2*, P(90°)=−0.42 *4* (1989By03); A_2=0.29 *2*, A_4=0.01 *3* (1983Hu15).
482.8 *2*	1.2 *1*	5875.4		5392.6		(M1)		Mult.: A_2=−0.22 *11*, A_4=0.09 *11*, P(90°)=−0.05 *15* (1989By03).
[x]505.7 *2*	1.30 *7*					D		A_2=−0.04 *9* (1989By03);
511[a] *1*		6452?		5941.0				
516.2 *2*	37.1 *19*	3895.4	31/2⁻	3379.3	29/2⁻	M1(+E2)	<0.5	Mult.: α(K)exp=0.082 *10*; A_2=−0.25 *2*, A_4=−0.02 *3* (1977Br05); A_2=−0.28 *2*, A_4=0.00 *2*, P(90°)=−0.09 *3* (1989By03).
523.6 *2*	6.3 *3*	4694.9	37/2⁻	4171.3	35/2⁻	M1+E2		Mult.: A_2=−0.46 *3*, A_4=−0.02 *4*, P(90°)=−0.19 *5* (1989By03). The sign of δ is negative (figure 3 in 1989By03).
527.8 *2*	3.0 *2*	1837.9	15/2⁻	1310.1	(15/2⁻,13/2⁺)	D		Mult.: A_2=−0.14 *6*, A_4=−0.02 *8*, P(90°)=0.17 *16* (1989By03).
533.2 *2*	1.0 *1*	1701.23	15/2⁻	1167.80	15/2⁻	M1		Mult.: A_2=0.20 *10* (1989By03), consistent with J to J transition.
550.5 *5*	0.80 *4*	5484.3	37/2⁺	4933.7	37/2⁻	(E1)		Mult.: A_2=−0.11 *13* (1989By03).
591.3 *2*	1.50 *8*	1701.23	15/2⁻	1110.09	13/2⁻	M1		Mult.: A_2=−0.66 *25*, A_4=−0.03 *31* (1989By03).
599.9 *2*	47.5 *24*	3379.3	29/2⁻	2779.8	27/2⁺	E1		Mult.: α(K)exp=0.0049 *6*; A_2=−0.14 *3*, A_4=0.04 *4* (1977Br05); A_2=−0.18 *2*, A_4=−0.01 *2*, P(90°)=0.45 *4* (1989By03); A_2=−0.18 *2*, A_4=−0.01 *2* (1983Hu15).
631.3 *2*	3.6 *2*	4649.9	35/2⁻	4019.0	33/2⁻	M1		Mult.: A_2=−0.41 *7*, A_4=0.03 *7*, P(90°)=−0.05 *8* (1989By03).
640.9 *2*	65.1 *33*	2779.8	27/2⁺	2138.5	25/2⁺	M1+E2		Mult.: α(K)exp=0.070 *7*; A_2=−0.60 *3*, A_4=0.00 *4* (1977Br05); A_2=−0.45 *1*, A_4=−0.01 *1*, P(90°)=−0.02 *1* (1989By03); A_2=−0.44 *2*, A_4=−0.02 *2* (1983Hu15).
697.4 *2*	83.9 *42*	2041.29	17/2⁺	1343.98	17/2⁻	E1		Mult.: α(K)exp=0.0062 *7*; A_2=0.22 *5*, A_4=0.05 *6* (1977Br05); A_2=0.36 *2*, A_4=0.00 *2*, P(90°)=−0.54 *1* (1989By03); A_2=0.35 *2*, A_4=0.01 *2* (1983Hu15).
[x]702.9 *2*	2.6 *1*					D		A_2=−0.11 *9* (1989By03);
711.1 *2*	2.7 *1*	5406.0	39/2⁽⁻⁾	4694.9	37/2⁻	D		Mult.: A_2=−0.47 *11*, A_4=0.03 *18*, P(90°)=−0.26 *31* (1989By03).
720.1 *2*	6.6 *3*	2064.2	21/2⁺	1343.98	17/2⁻	M2		Mult.: α(K)exp=0.071 *15* (1977Br05); A_2=0.15 *3*, A_4=0.01 *5*, P(90°)=−0.19 *10* (1989By03); A_2=0.11 *3*, A_4=−0.02 *4* (1983Hu15).
762.4 *2*	5.0 *3*	4933.7	37/2⁻	4171.3	35/2⁻	M1		Mult.: A_2=−0.30 *3*, A_4=0.02 *4*, P(90°)=−0.08 *10* (1989By03).
776.2 *5*	0.50 *3*	4957.5	33/2⁺	4181.0	31/2⁺	M1		Mult.: A_2=−0.62 *8*, A_4=−0.03 *10*, P(90°)=−0.09 *10* (1989By03).
789.4 *2*	1.2 *1*	5484.3	37/2⁺	4694.9	37/2⁻	(E1)		Mult.: A_2=0.42 *19* (1989By03), consistent with a J to J transition.
796.0 *2*	47.7 *24*	796.00	11/2⁻	0	9/2⁻	M1+E2		Mult.: α(K)exp=0.033 *4*; A_2=−0.52 *3*, A_4=0.02 *4* (1977Br05); A_2=−0.53 *1*, A_4=0.02 *1*, P(90°)=0.11 *2* (1989By03); A_2=−0.54 *2*, A_4=0.01 *2* (1983Hu15). The sign of δ is negative (figure 3 in 1989By03).
834.8 *2*	4.2 *2*	5484.3	37/2⁺	4649.9	35/2⁻	(E1)		Mult.: A_2=−0.18 *5*, A_4=0.15 *7* (1989By03).
843 *1*	<9	6718.4		5875.4				
873.6 *2*	18.2 *9*	2041.29	17/2⁺	1167.80	15/2⁻	E1		Mult.: α(K)exp<0.004; A_2=−0.14 *4*, A_4=−0.04 *5* (1977Br05); A_2=−0.14 *3*, A_4=0.00 *4*, P(90°)=0.38 *2* (1989By03); A_2=−0.16 *2*, A_4=0.02 *3* (1983Hu15).
881.3 *2*	100 *5*	881.42	13/2⁻	0	9/2⁻	E2		Mult.: α(K)exp=0.0093 *11*; A_2=0.27 *3*, A_4=0.02 *4* (1977Br05); A_2=0.29

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γ(^{205}Bi) (continued)

E_γ †	I_γ †	E_i(level)	J^π_i	E_f	J^π_f	Mult.#	Comments
							1, A_4=−0.03 *1*, P(90°)=0.53 *2* (1989By03); A_2=0.27 *2*, A_4=−0.04 *2* (1983Hu15).
[x]898 *2*	<2						
980.5 *2*	1.0 *1*	4181.0	31/2$^+$	3200.5	29/2$^+$	(M1)	Mult.: A_2=−0.95 *17*, A_4=−0.00 *21*, P(90°)=0.08 *24* (1989By03).
[x]1037.1 *2*	<3						
1059.1 *2*	5.0 *3*	3197.2	27/2$^+$	2138.5	25/2$^+$	M1	Mult.: A_2=−0.32 *3*, A_4=−0.01 *4*, P(90°)=−0.21 *11* (1989By03).
1061.8 *2*	4.1 *2*	4957.5	33/2$^+$	3895.4	31/2$^-$	(E1)	Mult.: A_2=0.31 *6*, A_4=−0.01 *5*, P(90°)=0.8 *4* (1989By03). Note, that the measured A_2 coefficient is in disagreement with such an assignment.
1110.2 *2*	18.7 *9*	1110.09	13/2$^-$	0	9/2$^-$	E2	Mult.: A_2=0.30 *1*, A_4=−0.04 *2*, P(90°)=0.66 *7* (1989By03); A_2=0.28 *2*, A_4=−0.03 *2* (1983Hu15).
[x]1130.9 *2*	<5						
[x]1143.1 *2*	<5						

† From 1989By03, unless otherwise stated.

‡ From 1977Br05.

From α(K)exp and subshell ratios, $\gamma(\theta)$, linear γ-ray polarization (P(90°)) and multiple decay branches in 1989By03, 1983Hu15 and 1977Br05.

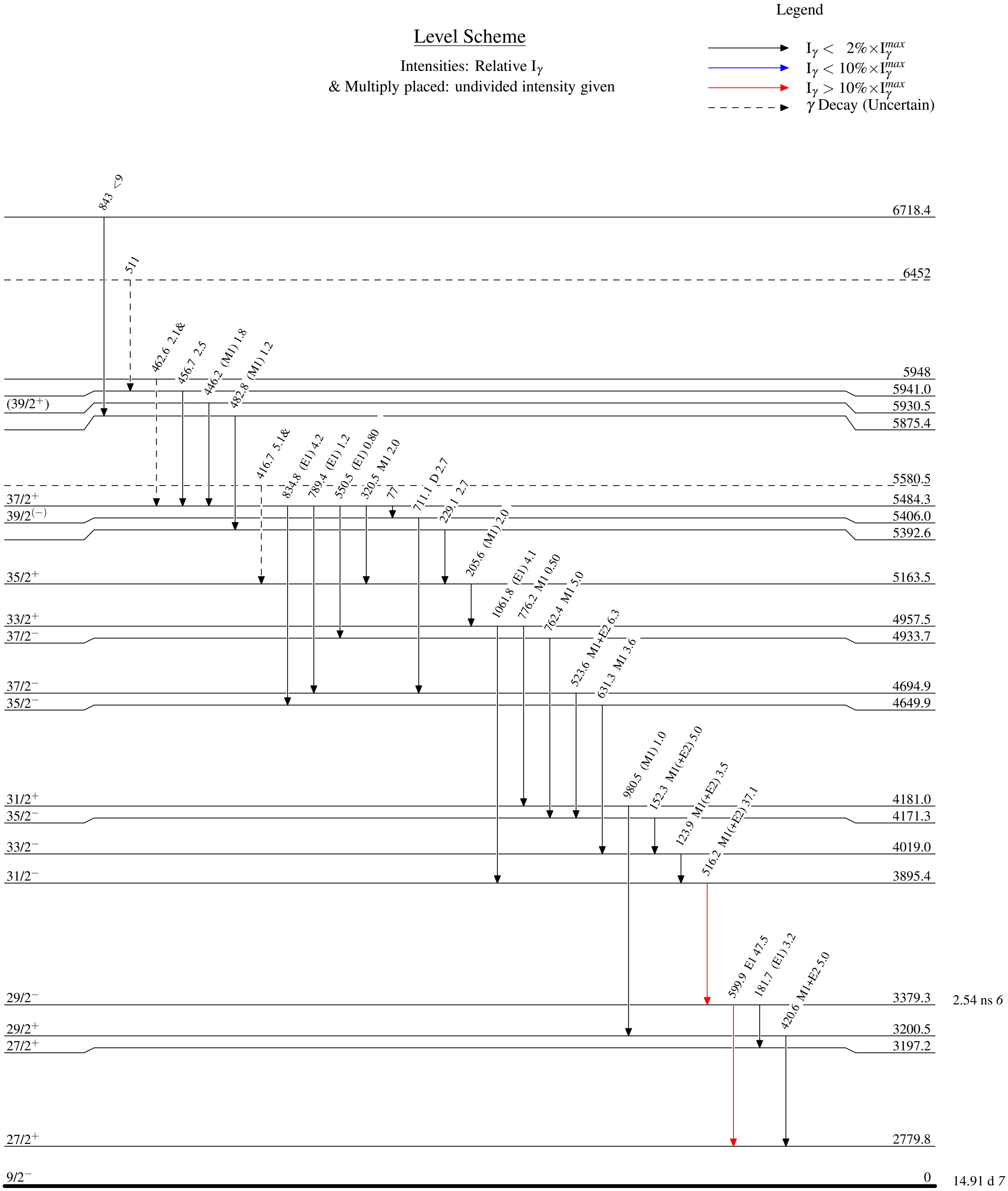
@ From 1977Br05.

& Multiply placed with undivided intensity.

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

[x] γ ray not placed in level scheme.

$^{205}Tl(\alpha,4n\gamma)$ 1989By03,1983Hu15,1977Br05



$^{205}_{83}Bi_{122}$

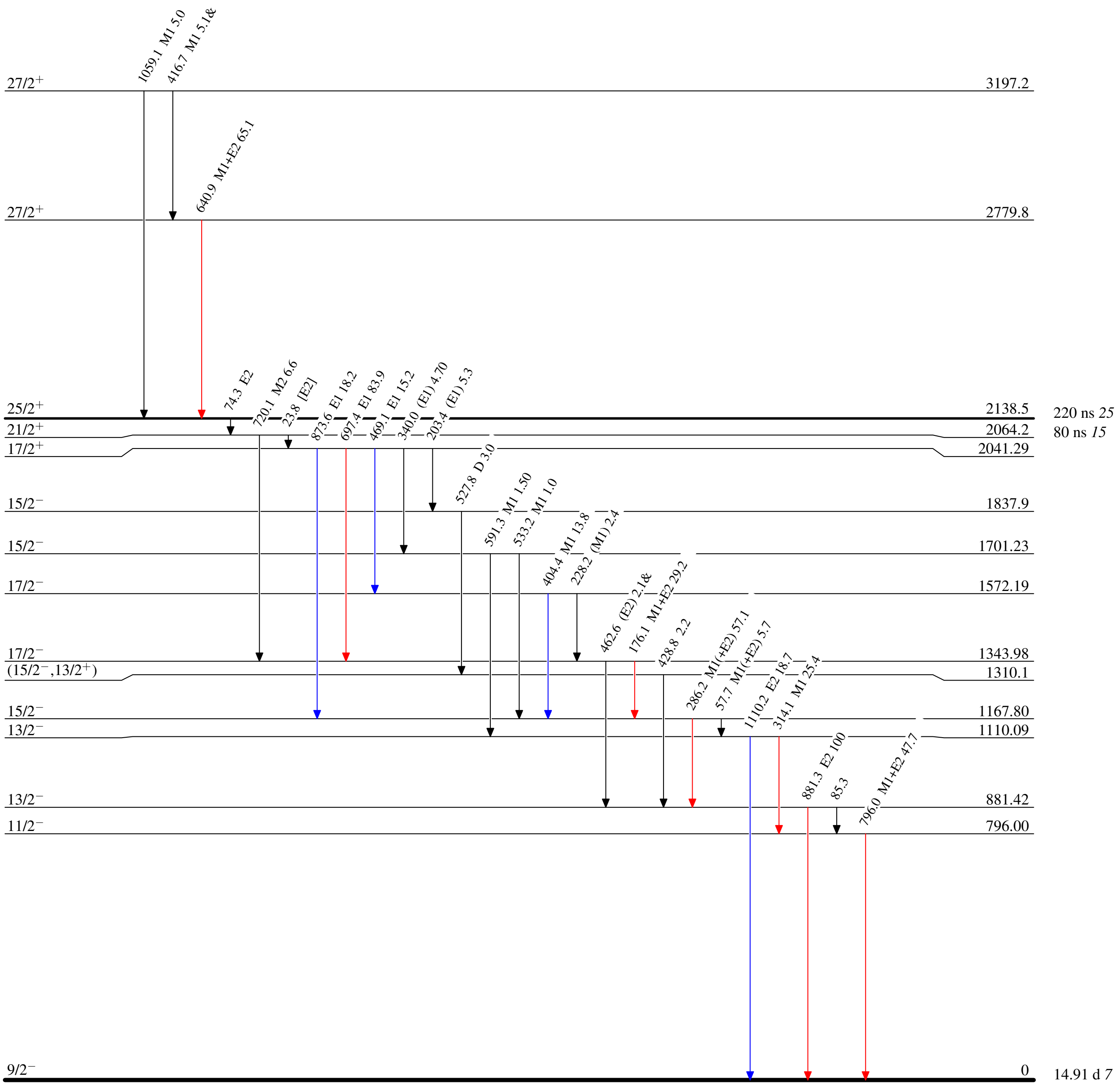
$^{205}Tl(\alpha,4n\gamma)$ 1989By03,1983Hu15,1977Br05

Level Scheme (continued)

Intensities: Relative I_γ
& Multiply placed: undivided intensity given

Legend

- $I_\gamma < 2\% \times I_\gamma^{max}$ (black)
- $I_\gamma < 10\% \times I_\gamma^{max}$ (blue)
- $I_\gamma > 10\% \times I_\gamma^{max}$ (red)



$^{205}_{83}Bi_{122}$