Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	J. C. Batchelder and A. M. Hurst, M. S. Basunia	NDS 183, 1 (2022)	1-Mar-2022

Q(β^-)=−5202 *23*; S(n)=8197×10^3 *29*; S(p)=988 *25*; Q(α)=5.996 *26* 2021Wa16

2020St11: ^{186}Tl from U(p, X), E=1.4 GeV spallation reaction; measured Eα, Iα, Eγ, Iγ, ce, Eβ, aγ-, a$\gamma\gamma$- and α(x ray)-coin, half-lives of ^{186}Tl (2^-) ground state and (10^-) isomer. Spede spectrometer and five HPGe clover detectors. Deduced levels, J, π, (2^-) as the ground state, energies of the (7^+) and $10^{(-)}$ isomers, upper limit of %IT decay and lower limit of %β+ branching ratios from the decay of the (10^-) isomer of ^{186}Tl.

^{186}Tl Levels

Cross Reference (XREF) Flags

A	^{186}Tl IT decay	D	^{142}Nd(^{48}Ti,p3nγ)
B	^{190}Bi α decay: low spin	E	^{159}Tb(^{32}S,5nγ),^{155}Gd(^{35}Cl,4nγ)
C	^{190}Bi α decay: high spin		

E(level)†	J$^\pi$	T$_{1/2}$	XREF	Comments
0.0	(2^-)	3.4 s *+5−4*	B	%α=? Additional information 1. E(level): 2020St11 propose 2^- state as the g.s. of ^{186}Tl based on the measured Eα=5670 keV *51* feeding the 129 keV level in ^{182}Au and measured mass of the 7^+ state in the literature. J$^\pi$: E1 293.7γ from (3^+). T$_{1/2}$: From α-γ coin (t) (2020St11). Other: 4.16 s *10* (from α(t) − possible α contribution from 7^+ state (27.5 s) − 2020St11 note). %α − 2020St11 identified α=5670 keV *51* decay from this level. Unable to extract the %α branching due to poor energy resolution. configuration=[πs$_{1/2}$•νi$_{3/2}$].
40 *39*	(7^+)	27.5 s *10*	A CDE	%ε+%β^+≈99.994; %α≈0.006 μ=0.497 *9* (1995Sc54) E(level): Weighted ave. of 20 keV *40* (2014Bo26, 2017Au03) from mass measurement, and 77 keV *56* (2020St11) from α decay studies. J$^\pi$: Systematics of heavier odd-odd Tl isotopes. Probable configuration=((π s$_{1/2}$)+(ν i$_{13/2}$))$_{7+}$ (1981Kr20). T$_{1/2}$: From 1977Co21 (γ(t) − ^{186}Tl ε decay). Other values: 27 s *3* (1977Be23), 28 s *2* (1975Ha27), 48 s *3* (1974Ha10), 30 s *5* (1976To06), ~30 s (1976Ij01). %α: From 1977Ij01. 2020St11 also notes for evidences of small α branch from this level. μ,Q: From fast beam collinear laser spectroscopy (1995Sc54). μ measured relative to μ(^{205}Tl) − not listed in 2020StZV. Also reported Q=0.06 10 (1995Sc54), does not include Sternheimer correction. N.J. Stone (2016St14) by email (dated: 01/21/21) opined that it fails the criterion for considering/listing. δ<r^2>(^{186m}Tl,^{205}Tl)=−0.9324 fm^2 *15* (unc of iso. shift) *650* (sys) (reported in 2013Ba41 based on data from 1995Sc54).
104.6 *9*	(4^+)		B	J$^\pi$: 105γ M2 to (2^-), α from (3^+).
129 *39*	(6^+,7^+,8^+)	≤0.4 ns	A C	J$^\pi$: M1 89.5γ to (7^+); absence of γ from (10^-) isomer; possible configuration=((π 3s$_{1/2}$)-(ν i$_{13/2}$))$_{6+}$ (based on expected E splitting for 3s$_{1/2}$-i$_{13/2}$ doublet (1991Va04)) favors J^π=6^+. T$_{1/2}$: From ^{190}Bi α decay: high spin (1991Va04). E(level): See level 414 keV.
215.2 *9*	(2^-)		B	J$^\pi$: Based on (E1) from (3^+), proposed by evaluators.
293.7 *3*	(3^+)	11 ns *4*	B	J$^\pi$: From systemtics of heavier odd-odd Tl isotopes. Unhindered α decay from

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Adopted Levels, Gammas (continued)

^{186}Tl Levels (continued)

E(level)†	Jπ	$T_{1/2}$	XREF	Comments
				(3^+) parent. Possible configuration=((π $1h_{9/2}$)-(ν $3p_{3/2}$))$_{3+}$ (1991Va04).
				$T_{1/2}$: From ^{190}Bi α decay: low spin (1991Va04).
295 *39*			C	E(level): See level 414 keV.
314.0 *10*			B	
321 *39*			C	E(level): See level 414 keV.
396 *39*			A C	E(level): See level 414 keV.
				Jπ: (7^+) in 2020St11.
414 *39*	(10^-)	3.32 s *11*	A CDE	%IT<94.1 *3*; %ε+%β^+>5.9 *3*
				μ=2.56 *6* (2019StZV,2013Ba41)
				E(level): Other: 390 40 (2021Ko07).
				δ<r^2>(^{186m}Tl,^{205}Tl)=−0.719 fm^2 *23* (unc of iso. shift) *50* (sys) (2013Ba41).
				E(level): x=77 keV *56* (2020St11) yields isomeric level energy of 451 keV *56* and 396 keV *39* from mass measurement in 2014Bo26, 2017Au03. Wt. ave. 414 keV *39* (uncertainty is the lowest input value).
				Jπ: from systematics, E3 to (7^+); unhindered α decay from (10^-) parent. J=10 gives good agreement between measured 2.55(6) and calculated and calculated 2.27 *1* magnetic moment (2013Ba41). For details of the calculation see (2013Ba41, 2012Ba32, 1986Ul02). Possible configuration=(π $h_{9/2}$)(ν $i_{13/2}$)10^-.
				$T_{1/2}$: Wt. ave. of data from ^{186}Tl IT decay: 3.40 s *9* (2020St11), 3 s *1* (1977Be23), 4.5 s *13* (1977Co21), 4.5 s *+10−15* (1975Ha27), and (^{32}S,5nγ),(^{35}Cl,4nγ): 2.9 S 2 (1981Kr20).
				μ: Laser spectroscopy − with hyperfine structure anomaly (HFA) correction. Value without HFA correction is 2.568 *61* (2013Ba41,2019StZV).
				%IT and %ε+%β^+ from 2020St11.
				configuration=[$\pi h_{9/2} \bullet \nu i_{13/2}$].
481 *39*			C	E(level): See level 414 keV.
506.7 *11*			B	
690 *39*	(11^-)		DE	Jπ: 275.9γ D to (10^-).
				E(level): See level 414 keV.
1011 *39*	(12^-)		DE	Jπ: 321.7γ D+Q to (11^-).
				E(level): See level 414 keV.
1255 *39*	(13^-)		D	Jπ: 243.4γ D+Q to (12^-).
				E(level): See level 414 keV.
1363 *39*	(13^-)		D	Jπ: 352.1γ D to (12^-).
				E(level): See level 414 keV.

† From a least-squares fit to γ-ray energies except as noted.

γ(^{186}Tl)

E_i(level)	J_i^π	E_γ†	I_γ	E_f	J_f^π	Mult.@	α&	Comments
104.6	(4^+)	105‡ *1*	100	0.0	(2^-)	M2	60.5 *24*	α(K)=39.5 *15*; α(L)=15.7 *7*; α(M)=4.03 *18* α(N)=1.03 *5*; α(O)=0.196 *9*; α(P)=0.0156 *7* Mult.: From α(K)exp=36 *5* (2003An26 − ^{190}Bi α decay: low spin).
129	(6^+,7^+,8^+)	89.5# *4*	100	40	(7^+)	M1	11.76 *22*	α(K)=9.58 *18*; α(L)=1.67 *4*; α(M)=0.390 *8* α(N)=0.0985 *19*; α(O)=0.0191 *4*; α(P)=0.00180 *4* B(M1)(W.u.)>0.0059 Mult.: From α(K)exp=10.3 *9* (2003An26−^{190}Bi α decay: high spin).
215.2	(2^-)	111‡ *1*	100	104.6	(4^+)			
293.7	(3^+)	79 *1*		215.2	(2^-)	(E1)	0.167 *7*	α(L)=0.128 *5*; α(M)=0.0301 *12*

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Adopted Levels, Gammas (continued)

γ(^{186}Tl) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ	E_f	J_f^π	Mult.[@]	α[&]	Comments
								α(N)=0.0074 *3*; α(O)=0.00134 *5*; α(P)=8.6×10^{-5} *3* Mult.: From α_{tot}=0.3 *2*, deduced by authors of 2003An26 (^{190}Bi α decay: low spin) assuming cascade character of 105γ and 79γ. α_{theo}=0.17 *1* (E1), 3.1 *1* (M1), and 16 *1* (E2).
293.7	(3$^+$)	293.7[‡] *3*		0.0	(2$^-$)	E1	0.0301	α(K)=0.0247 *4*; α(L)=0.00414 *6*; α(M)=0.000962 *14* α(N)=0.000241 *4*; α(O)=4.55×10^{-5} *7*; α(P)=3.72×10^{-6} *6* Mult.: From α(K)exp in ^{190}Bi α decay: low spin.
295		255[#] *1*	100	40	(7$^+$)			
314.0		314[‡] *1*	100	0.0	(2$^-$)			
321		281[#] *1*	100	40	(7$^+$)			
396		267[#]		129	(6$^+$,7$^+$,8$^+$)			
		356[#] *1*		40	(7$^+$)			
414	(10$^-$)	374.2 *1*	100	40	(7$^+$)	E3	0.249	B(E3)(W.u.)=0.000159 *11* α(K)=0.1009 *15*; α(L)=0.1105 *16*; α(M)=0.0292 *5* α(N)=0.00736 *11*; α(O)=0.001306 *19*; α(P)=6.72×10^{-5} *10* E_γ: From ^{186}Tl IT decay. Other: 374.0 *2* (^{32}S,5nγ),(^{35}Cl,4nγ). Mult.: From α(K)exp=0.095 *17* and K/L=1.5 *9* in ^{186}Tl IT decay.
481		352[#]		129	(6$^+$,7$^+$,8$^+$)			
		441[#] *1*		40	(7$^+$)			
506.7		213[‡] *1*	100	293.7	(3$^+$)			
690	(11$^-$)	275.9 *1*	100	414	(10$^-$)	D		
1011	(12$^-$)	321.7 *4*	100	690	(11$^-$)	D+Q		
		597 *1*	100	414	(10$^-$)			
1255	(13$^-$)	243.4 *3*	100	1011	(12$^-$)	D+Q		
1363	(13$^-$)	352.1 *4*	91 *26*	1011	(12$^-$)	D		I_γ: from ^{142}Nd(^{48}Ti,p3nγ).
		672.9 *5*	100 *35*	690	(11$^-$)			I_γ: from ^{142}Nd(^{48}Ti,p3nγ).

[†] From (^{48}Ti,p3nγ) except as noted.
[‡] From 2003An26 – ^{190}Bi α decay: low spin.
[#] From 2003An26 – ^{190}Bi α decay: high spin.
[@] From ^{142}Nd(^{48}Ti,p3nγ), except otherwise noted.
[&] Additional information 2.

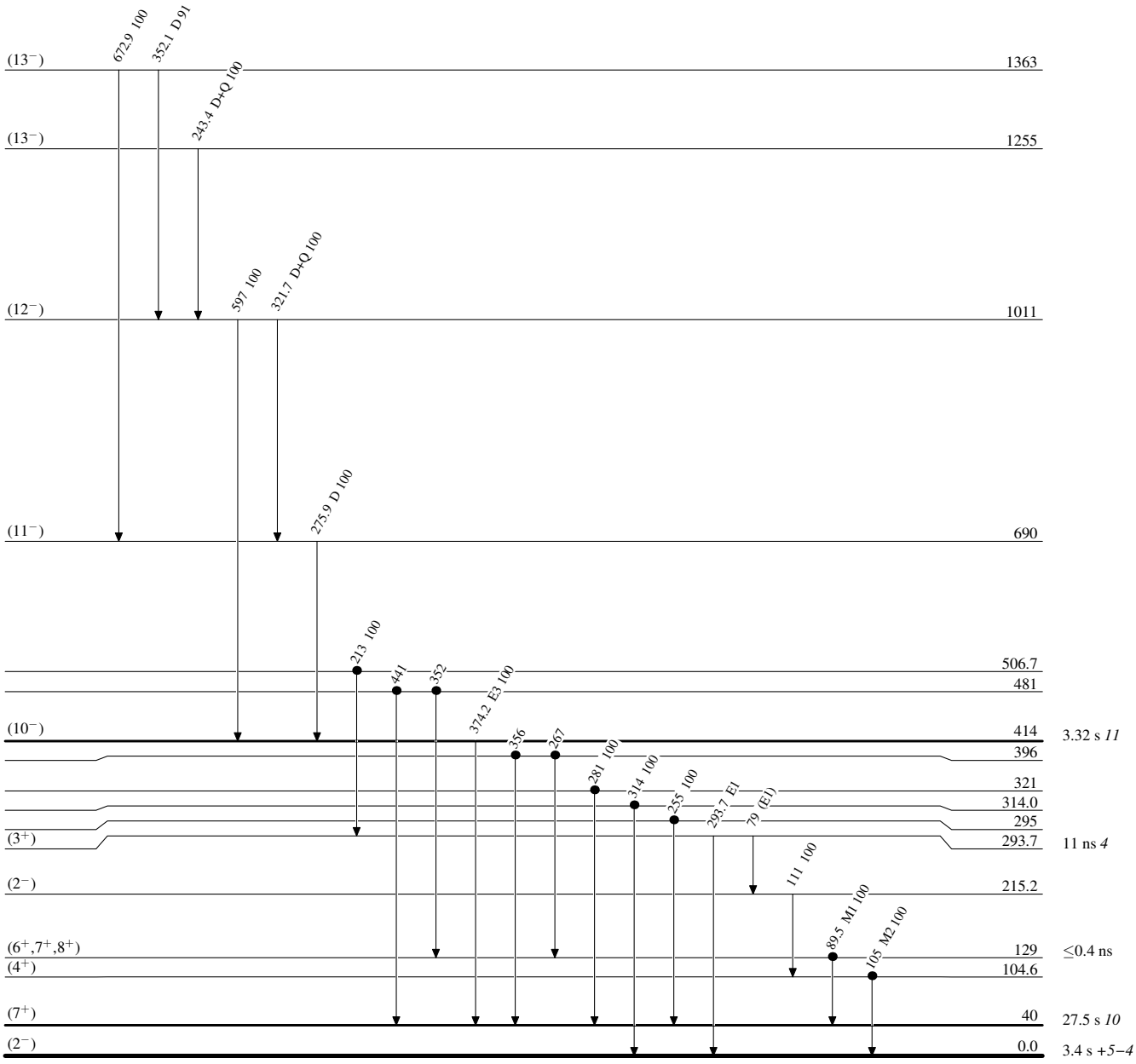
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

● Coincidence



$^{186}_{81}Tl_{105}$