^{208}Tl β^- decay

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	M. J. Martin	NDS 108,1583 (2007)	1-Jun-2007

Parent: ^{208}Tl: E=0.0; J$^\pi$=5$^+$; $T_{1/2}$=3.053 min *4*; Q(β^-)=4999.0 *17*; %β^- decay=100.0

^{208}Pb Levels

The level scheme is that of 1975Ko02 and is based on extensive coincidence data. 2004BeZQ suggest placement of the 808.3 and 835.9 transitions As feeding the 3475 level, giving new levels At 4283.4 and 4311.0. The evaluator has not adopted these placements since the resulting levels have not been seen In any other reaction. These transitions do not fit between any of the known levels below the ^{208}Tl Q(β^-) value of 5000. Furthermore, As pointed out by 1997Sc21, all the states expected from single-particle-single-hole excitations up to the 8$^+$ state At 4611 have been identified.

E(level)	J$^\pi$	$T_{1/2}$	Comments
0.0	0$^+$		
2614.529 *10*	3$^-$	16.7 ps *3*	g=0.54 *7* $T_{1/2}$: from Adopted Levels, based on B(E3) In Coulomb excitation and (e,e′). 1962We14 report 32 ps *11* from $\gamma\gamma$(t). g-factor: weighted average of 1969Bo12 ($\omega\tau$/H=5.9×10^{-8} *15*) and 1973ScYX ($\omega\tau$/H=6.3×10^{-8} *9*) with $T_{1/2}$=16.7 ps *3* (see Adopted Levels).
3197.717 *11*	5$^-$	294 ps *15*	g=0.023 *5* $T_{1/2}$: weighted average of βce(t) data of 1971Va24 (286 ps *26*) and $\gamma\gamma$(t) data of 1962We14 (298 ps *18*). Others: 1954El07, 1954El24. g: from 1969Bo01 based on $\omega\tau/\omega\tau$(2614 level)=0.74 *12*, g-factor(2614 level)=0.54 *7*, with $T_{1/2}$(2614 level)=16.7 ps *3* and $T_{1/2}$(3197 level)=294 ps *15*. Other: 1965Jo12.
3475.088 *11*	4$^-$	4 ps *3*	$T_{1/2}$: from βce(t) (1971Va24).
3708.41 *7*	5$^-$	<100 ps	$T_{1/2}$: from βce(t) (1954El24).
3919.78 *10*	6$^-$		
3946.42 *20*	4$^-$		
3960.93 *7*	5$^-$	≤18 ps	$T_{1/2}$: from βce(t) (1971Va24).
3995.6 *5*	4$^-$		
4125.28 *17*	5$^-$		
4180.38 *17*	5$^-$		
4262.0 *7*	4$^-$		
4296.28 *20*	5$^-$		
4323.4 *4*	4$^+$		
4358.44 *17*	4$^-$		
4382.9 *3*	6$^-$		
4480.5 *3*	6$^-$		

β^- radiations

E(decay)	E(level)	Iβ^- †‡	Log *ft*	Comments
(518.5 *17*)	4480.5	0.052 *5*	6.67 *5*	av Eβ=154.43 *59*
(616.1 *17*)	4382.9	0.017 *5*	7.4 *2*	av Eβ=187.88 *61*
(640.6 *17*)	4358.44	0.044 *5*	7.05 *5*	av Eβ=196.43 *60*
(675.6 *18*)	4323.4	0.005 *2*	8.1 *2*	av Eβ=208.79 *62*
(702.7 *17*)	4296.28	0.101 *21*	6.83 *9*	av Eβ=218.44 *62*
(737.0 *18*)	4262.0	0.002 *1*	8.6 *2*	av Eβ=230.73 *67*
(818.6 *17*)	4180.38	0.227 *9*	6.70 *2*	av Eβ=260.44 *63*
(873.7 *17*)	4125.28	0.175 *23*	6.92 *6*	av Eβ=280.78 *64*
(1003.4 *18*)	3995.6	0.007 *3*	8.5 *2*	av Eβ=329.64 *68*
(1038.1 *17*)	3960.93	3.18 *6*	5.92 *1*	av Eβ=342.90 *66*

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^{208}Tl β^- decay (continued)

β^- radiations (continued)

E(decay)	E(level)	Iβ^- [†‡]	Log *ft*	Comments
(1052.6 *17*)	3946.42	0.046 *3*	7.78 *3*	av Eβ=348.43 *66*
(1079.2 *17*)	3919.78	0.63 *5*	6.68 *4*	av Eβ=358.70 *66*
(1290.6 *17*)	3708.41	24.2 *3*	5.38 *1*	av Eβ=441.53 *68*
(1523.9 *17*)	3475.088	22.2 *5*	5.68 *1*	av Eβ=535.39 *70*
(1801.3 *17*)	3197.717	49.1 *7*	5.61 *1*	av Eβ=649.48 *71*

† From I(γ+ce) imbalance for each level.
‡ Absolute intensity per 100 decays.

γ(^{208}Pb)

Iγ normalization: from the decay scheme one has the requirement that the total intensity of the 2614γ, gammas, conversion electrons, and internal pairs, is 100.
$\gamma\gamma(\theta)$: 1961Si11, 1962Wo05, 1964Sp06, 1967Jo17, 1972Ja25, 1976Av03. The following cascades have been studied:
The transitions In parentheses denote intermediate unobserved transitions. From 1), data of 1967Jo17 and 1972Ja25 are consistent with mult(583γ)=Q. Data of 1961Si11 and 1962Wo05 require a small L=3 admixture. The data of 1972Ja25 allow δ(O/Q)<0.008 and negative. From $T_{1/2}$(3197 level) and the recommended upper limit on γ-ray strengths Q must Be E2 with δ(M3/E2)<0.0012. The evaluator adopts mult=E2 from 2), values of +0.013 *11* (1962Wo05), +0.014 *12* (1972Ja25), and +0.015 *12* (1976Av03) give a weighted average of δ(860γ)=+0.014 8. 1961Si11 report δ=+0.032 *6*. From 3), data of 1976Av03 yield δ(277γ)=+0.008 *11*. From 4), data of 1976Av03 yield δ(511γ)=−0.052 *45* or −0.68 *8*. From 5), data of 1976Av03 yield δ(722γ)=+0.31 *7*. From 6), data of 1976Av03 yield δ(763γ)=−0.01 *6* from 7), data of 1961Si11 yield δ(763γ)=−0.16 *+9−8*. From 8), data of 1972Ja25 yield δ(277γ)=4.8 *4*, In disagreement with 3) and with ce data. These data of 1972Ja25 are not used. From 9), data of 1972Ja25 yield δ(511γ)≈−0.8, In agreement with the large solution from 4).

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1) 583γ-2615γ, 2) 860γ-2615γ, 3) 277γ-583γ, 4) 511γ-583γ,
5) 722γ-583γ,  6) 763γ-583γ,  7)  763γ-(583γ)-2615γ,
8) 277γ-(583γ)-2615γ, 9) 511γ-(583γ)-2615γ.
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E_γ [†]	I_γ [‡a]	E_i(level)	J^π_i	E_f	J^π_f	Mult. [&]	δ [#]	α [b]	Comments
211.40 *15*	0.18 *1*	3919.78	6⁻	3708.41	5⁻	M1(+E2)	+0.04 [@] *+7−6*	1.126 *16*	α(K)=0.922 *16*; α(L)=0.1586 *23*; α(M)=0.0372 *6*; α(N+..)=0.01153 *17* α(N)=0.00945 *14*; α(O)=0.00188 *3*; α(P)=0.000201 *3* Mult.: from α(K)exp=0.89 (1957Kr56) and α(L1)exp=0.14 (1957Vo22).
233.36 *15*	0.31 *1*	3708.41	5⁻	3475.088	4⁻	M1+E2	≈0.6	≈0.70	α(K)≈0.547; α(L)≈0.1155; α(M)≈0.0277; α(N+..)≈0.00854 α(N)≈0.00704; α(O)≈0.001373; α(P)≈0.0001297 Mult.,δ: α(L1)exp=0.10 *2* (1957Vo22) gives δ<0.7, and α(K)exp=0.45 *9* (1957Kr56) gives δ=0.9 *3*. No L2 or L3 lines were seen In the spectrum of 1957Vo22, suggesting mult mainly M1; however, δ=0.6

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^{208}Tl β^- decay (continued)

$\gamma(^{208}Pb)$ (continued)

E_γ[†]	I_γ[‡a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[&]	δ[#]	α[b]	Comments
									gives L1:L2:L3=100:27:11, consistent with the non-observation of these lines.
252.61 *10*	0.78 *2*	3960.93	5^-	3708.41	5^-	M1(+E2)	−0.35[@] *10*	0.63 *3*	α(K)=0.51 *3*; α(L)=0.0941 *19*; α(M)=0.0222 *4*; α(N+..)=0.00688 *13* α(N)=0.00565 *10*; α(O)=0.001117 *22*; α(P)=0.000115 *5* Mult.: from α(K)exp=0.49 *17* (1978Av01), 0.52 *11* (1957Vo22).
277.371 *5*	6.6 *3*	3475.088	4^-	3197.717	5^-	M1+E2	+0.017 *11*	0.533	α(K)=0.436 *7*; α(L)=0.0745 *11*; α(M)=0.01744 *25*; α(N+..)=0.00541 *8* α(N)=0.00443 *7*; α(O)=0.000884 *13*; α(P)=9.45×10^{-5} *14* E_γ: from the decay scheme (860.557 *4* − 583.187 *2*) (corrected for recoil). 1977Ku25 report 277.351 *10*. A revision upward to 277.359 *10* is required to account for changes In the energies of the calibration lines used by 1977Ku25. Other: 277.35 *6* (1952Mu45). Mult.: from α(K)exp=0.36 *4* (1978Av01), and α(L1)exp=0.075 *10* (1963Da11). Other: 1957Vo22.
485.95 *15*	0.049 *4*	3960.93	5^-	3475.088	4^-				
510.77 *10*	22.6 *2*	3708.41	5^-	3197.717	5^-	M1+E2	−0.052 *45*	0.1027 *16*	α(K)=0.0842 *13*; α(L)=0.01419 *21*; α(M)=0.00332 *5*; α(N+..)=0.001029 *15* α(N)=0.000842 *13*; α(O)=0.0001680 *25*; α(P)=1.80×10^{-5} *3* Mult.: α(K)exp=0.080 *4* (1978Av01) and 0.087 *5* (1963Da11) give δ<0.39 and <0.20, respectively. Other: α(K)exp=0.082 *17* (1956Kr57). From $\gamma\gamma(\theta)$ one gets δ=−0.052 *45* or −0.68 *8*. α(K)exp rules out the larger solution. Note, however, that δ=−0.52 *+7−5* is reported In (n,n′γ).
583.187 *2*	85.0 *3*	3197.717	5^-	2614.529	3^-	E2		0.0205	α(K)=0.01511 *22*; α(L)=0.00411 *6*; α(M)=0.001010 *15*; α(N+..)=0.000309 *5* α(N)=0.000256 *4*; α(O)=4.88×10^{-5} *7*; α(P)=4.05×10^{-6} *6*

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^{208}Tl β^- decay (continued)

$\gamma(^{208}Pb)$ (continued)

E_γ[†]	I_γ[‡a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[&]	δ[#]	α[b]	Comments
									E_γ: from 2000He14. Mult.: from α(K)exp=0.0152 *11* (1954El07). α(K)=0.01511 (E2 theory). Mult=Q is confirmed by $\gamma\gamma(\theta)$.
587.7	0.06 *2*	4296.28	5⁻	3708.41	5⁻				E_γ: from energy level difference.
650.1 *3*	0.05 *2*	4125.28	5⁻	3475.088	4⁻				
705.2 *3*	0.022 *4*	4180.38	5⁻	3475.088	4⁻				
722.04 *12*	0.24 *4*	3919.78	6⁻	3197.717	5⁻	M1+E2	+0.31 *7*	0.0390 *12*	α(K)=0.0320 *11*; α(L)=0.00539 *16*; α(M)=0.00126 *4*; α(N+..)=0.000391 *11* α(N)=0.000320 *9*; α(O)=6.38×10^{-5} *18*; α(P)=6.81×10^{-6} *21* Mult.: from α(K)exp≈0.045 (1978Av01) and $\gamma\gamma(\theta)$.
748.7 *2*	0.046 *3*	3946.42	4⁻	3197.717	5⁻				
763.13 *8*	1.79 *3*	3960.93	5⁻	3197.717	5⁻	M1+E2	−0.12 *5*	0.0356 *6*	E_γ: from 1969Br24.
^{x}808.3 *2*	0.030 *7*								E_γ,I_γ: reported only by 1993El08.
821.2 *2*	0.041 *4*	4296.28	5⁻	3475.088	4⁻				
^{x}835.9 *2*	0.076 *11*								E_γ,I_γ: reported only by 1993El08.
860.557 *4*	12.5 *1*	3475.088	4⁻	2614.529	3⁻	M1+E2	+0.014 *8*	0.0264	α(K)=0.0217 *3*; α(L)=0.00360 *5*; α(M)=0.000839 *12*; α(N+..)=0.000260 *4* α(N)=0.000213 *3*; α(O)=4.26×10^{-5} *6*; α(P)=4.57×10^{-6} *7* E_γ: 1979He10 report 860.564 *5*. The evaluator has decreased this value by 7 eV to correct for the change In energy of the 110m$\alpha\gamma$ calibration line from 884.6852 *30* In 1979He10 to 884.6781 *13* In 2000He14. Mult.: from α(K)exp=0.0246 *10* (1978Av01), 0.026 *4* (1963Da11), and 0.024 (1957Vo22).
883.3 *2*	0.031 *3*	4358.44	4⁻	3475.088	4⁻				
927.6 *2*	0.125 *11*	4125.28	5⁻	3197.717	5⁻				
982.7 *2*	0.205 *8*	4180.38	5⁻	3197.717	5⁻				
^{x}1004	<0.005								E_γ,I_γ: reported only by 1969Pa02 with I(γ)≈0.01. The Iγ limit is from 1975Ko02.
1093.9 *2*	0.43 *2*	3708.41	5⁻	2614.529	3⁻				I_γ: other: 0.36 *7* (2005VaZZ).
1125.7 *4*	0.005 *2*	4323.4	4⁺	3197.717	5⁻				
1160.8 *3*	0.011 *3*	4358.44	4⁻	3197.717	5⁻				
1185.2 *3*	0.017 *5*	4382.9	6⁻	3197.717	5⁻				
1282.8 *3*	0.052 *5*	4480.5	6⁻	3197.717	5⁻				
1381.1 *5*	0.007 *3*	3995.6	4⁻	2614.529	3⁻				
1647.5 *7*	0.002 *1*	4262.0	4⁻	2614.529	3⁻				E_γ: unplaced by authors. Placed by evaluator on the basis of data In (d,pγ) and (n,n′γ).
1744.0 *7*	0.002 *1*	4358.44	4⁻	2614.529	3⁻				
2614.511 *10*	99.754 *4*	2614.529	3⁻	0.0	0⁺	E3		0.00247	α(K)=0.001712 *24*; α(L)=0.000293 *5*; α(M)=6.87×10^{-5} *10*;

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^{208}Tl β^- decay (continued)

$\gamma(^{208}$Pb) (continued)

E_γ †	I_γ ‡a	E_i(level)	J_i^π	E_f	J_f^π	Mult.&	α b	Comments
								α(N+..)=0.000392 *6* α(N)=1.743×10^{-5} *25*; α(O)=3.46×10^{-6} *5*; α(P)=3.62×10^{-7} *5*; α(IPF)=0.000371 *6* E_γ: from 2000He14. Mult.: α(K)exp=0.00217 *24* (1963Da11), 0.00178 *12* (1954El07), 0.00183 *26* (1956Kr57, 1957Vo22). The E3 theory value is 0.001712. α: includes internal pair formation. α=0.00210, α(IPF)=0.00037.
3197.7	≤0.007	3197.717	5$^-$	0.0	0$^+$	[E5]	0.00333	α(K)=0.00266 *4*; α(L)=0.000506 *7*; α(M)=0.0001204 *17*; α(N+..)=3.73×10^{-5} *6* α(N)=3.06×10^{-5} *5*; α(O)=6.06×10^{-6} *9*; α(P)=6.24×10^{-7} *9* E_γ: rounded-off value from E(level). I_γ: from 2005VaZZ. Transition not observed.
3475.1	≤0.003	3475.088	4$^-$	0.0	0$^+$			E_γ: rounded-off value from E(level). I_γ: from 2005VaZZ. Transition not observed.
3708.4	≤0.004	3708.41	5$^-$	0.0	0$^+$			E_γ: rounded-off value from E(level). I_γ: from 2005VaZZ. Transition not observed.
3960.9	≤0.003	3960.93	5$^-$	0.0	0$^+$			E_γ: rounded-off value from E(level). I_γ: from 2005VaZZ. Transition not observed.

† From 1975Ko02, except where noted otherwise. Values quoted from 2000He14 are based on E(^{198}Au γ)=411.80205 *17*. Others: 1969La23, 1969Pa02, 1973Da38.

‡ Values given are intensities per 100 disintegrations of ^{208}Tl As recommended by 2004BeZQ, with two corrections made by the evaluator. Iγ(927.6γ) should Be 0.125 *11* rather than 0.125 *1*, As reported by 2004BeZQ, and Iγ(2614γ) should Be 99.754 *4* rather than 99.79 *1*. In the case of the 2614γ, the authors of 2004BeZQ obtained Iγ from the requirement Iγ=100/(1+α), with α=0.00210 *6* taken from 1978Ro22 with an uncertainty of 3% assigned to α. The internal pair formation coefficient cannot Be ignored. The requirement should read Iγ=100/(1+α+α(IPF)). With α taken As 0.00210 and α(IPF) taken As 0.00037 (2005KiZT) with a 1.4% uncertainty assigned to these quantities, one gets Iγ(2614γ)=99.754 *4*. The following sources were used by 2004BeZQ In their evaluation: 1960Em01, 1960Sc07, 1961Si11, 1969Au10, 1969La23, 1969Pa02, 1973Da38, 1972Ja25, 1975Ko02, 1977Ge12, 1978Av01, 1982Sa36, 1983Sc13, 1983Va22, 1984Ge07, 1992Li05, and 1993El08.

From $\gamma\gamma(\theta)$ except where noted otherwise.

@ From (n,n′γ) As given In Adopted Gammas.

& From ce data. Data of 1956Kr57, 1963Da11, and 1978Av01 are normalized to the Iγ data so that α(K)(583γ)=0.01516 (E2 theory). Data of 1957Zh05 and 1957Vo22 are normalized to the data of 1956Kr57. A summary of the data of 1956Kr57, 1957Zh05 and 1957Vo22 is given In 1957Kr56. The α(K)exp values of 1954El07 are from Ice(K)/Iγ with calibrated detectors.

a Absolute intensity per 100 decays.

b Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

x γ ray not placed in level scheme.

^{208}Tl β^- decay

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays