^{45}Ti ε decay 1971Zu01,1966Po04

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	T. W. Burrows	NDS 109, 171 (2008)	30-Oct-2007

Parent: ^{45}Ti: E=0.0; J$^{\pi}$=7/2^{-}; T$_{1/2}$=184.8 min *5*; Q(ε)=2062.1 *5*; %ε+%β^{+} decay=100.0
^{45}Ti-E,J$^{\pi}$,T$_{1/2}$: From the ^{45}Ti Adopted Levels.
^{45}Ti-Q(ε): From 2003Au03.
1966Po04 measured ce's and β^{+}'s (toroidal field spect) and γ's.
1971Zu01 measured γ's.
1986Bo06 measured γ's and investigated nuclear excitation via annihilation of positrons with atomic electrons.
Others: see 1992Bu01.

^{45}Sc Levels

All information is from the Adopted Levels.

E(level)	J$^{\pi}$	T$_{1/2}$	Comments
0	7/2^{-}	stable	
12.40 *5*	3/2^{+}	325.8 ms *42*	
376.50 *12*	3/2^{-}		
543.06 *14*	5/2^{+}		
720.12 *14*	5/2^{-}		
974.38 *15*	7/2^{+}		
1236.70 *25*	11/2^{-}		
1408.27 *20*	(7/2)$^{-}$		
1662.0 *4*	9/2^{-}		
1800.0? *5*	5/2^{+}		Primarily excited in the annihilation of positrons with atomic electrons (1986Bo06). See ^{45}Sc(e^{+},Xγ) for estimated σ's.

ε,β^{+} radiations

TI,IE(A) From intensity imbalance for each level based upon the relative Iγ data of 1971Zu01 and 1966Po04 and the absolute ce(K)(12.4γ)=1.2% *3* (1966Po04).

E(decay)	E(level)	Iβ^{+} ‡	Iε‡	Log *ft*	I($\varepsilon+\beta^{+}$)‡	Comments
(262.1# *7*)	1800.0?		9.8×10^{-5}† *14*	8.0† *1*	9.8×10^{-5} *14*	εK=0.8919; εL=0.09229; εM+=0.01577
(400.1 *7*)	1662.0		0.060 *6*	5.55 *5*	0.060 *6*	εK=0.8930; εL=0.09141; εM+=0.01560
(653.8 *5*)	1408.27		0.096 *9*	5.78 *4*	0.096 *9*	εK=0.8937; εL=0.09078; εM+=0.01548
(1087.7 *5*)	974.38		0.0102 *12*	7.20 *6*	0.0102 *12*	εK=0.8940; εL=0.09036; εM+=0.01540
(1342.0 *5*)	720.12	0.0135 *12*	0.133 *12*	6.26 *4*	0.147 *13*	av Eβ=133.26 *22*; εK=0.8122 *5*; εL=0.08197 *5*; εM+=0.013967 *8*
(1519.0# *5*)	543.06	<0.00052	<0.0011	>8.5	<0.0016	av Eβ=206.10 *22*; εK=0.6023 *8*; εL=0.06074 *8*; εM+=0.010350 *13*
(1685.6# *5*)	376.50	<0.002	<0.001	>8.5[1]	<0.003	av Eβ=276.07 *22*; εK=0.3886 *6*; εL=0.03917 *6*; εM+=0.006673 *10* Allowed spectrum assumed for calcuations.
(2049.7# *5*)	12.40	<0.003	<0.003	>9.6[1u]	<0.006	av Eβ=463.01 *23*; εK=0.3758 *4*; εL=0.03803 *5*; εM+=0.006480 *7* Log *ft*: uniqueness from ΔJ^{π}.
2066 *5*	0	84.80 *13*	14.89 *13*	4.591 *2*	99.685 *17*	av Eβ=438.93 *22*; εK=0.13359 *18*; εL=0.013456 *18*; εM+=0.002292 *3*

Continued on next page (footnotes at end of table)

^{45}Ti ε decay 1971Zu01,1966Po04 (continued)

ε,β^+ radiations (continued)

† From selection rules and systematics, a 1f7/2 → 2s1/2 should be two to three orders of magnitude less than a 1f/2 → 1d3/2 β-transition (*i.e.*, 9.5≤log *ft*(1801)≤10.5 relative to log *ft*(975)=7.2); therefore, 1801 state is primarily populated via nuclear excitation in annihilation of positrons with atomic electrons (1986Bo06). 1971Zu01 estimated $I\varepsilon<2\times10^{-4}$.

‡ Absolute intensity per 100 decays.

Existence of this branch is questionable.

γ(^{45}Sc)

Iγ normalization, I(γ+ce) normalization: From ce(K)(12.4γ)=1.2% *3*.
%ce(K): from comparison of the electron line areas with the β^+ spectrum area (1966Po04).

E_γ[†]	I_γ[†a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	δ[‡]	α[‡]	$I_{(\gamma+ce)}$[a]	Comments
12.40 *5*	0.033[#] *9*	12.40	3/2$^+$	0	7/2$^-$	(M2)		423 *9*	14 *4*	ce(K)/(γ+ce)=0.855 *10*; ce(L)/(γ+ce)=0.126 *4*; ce(M)/(γ+ce)=0.0156 *5*; ce(N)/(γ+ce)=0.000703 *22* α(K)=362 *8*; α(L)=53.5 *12*; α(M)=6.63 *15*; α(N)=0.298 *7* E_γ: from level energy. Comment added B. Singh, May 01, 2021. I_γ: from I(γ+ce) and α. Iγ value modified and comment modified by B. Singh, May 01, 2021. α: from BrIcc for M2. Other: 501 *43* from α(K)exp=428 *37*, and α=1.17(α(K)exp), the ratio of total α/α(K) (theory) from BrIcc. 2008Bu01 evaluation used K/L+=3. Comment added by B. Singh, May 01, 2021. %ce(K)=1.2×10^{-2} *3*. $I_{(\gamma+ce)}$: 1966Po04 gave I(γ+ce)=12 *3* based on ce(K) value only.
(166.4[&])	0.008 *5*	543.06	5/2$^+$	376.50	3/2$^-$	(E1)		0.00518 *8*		α=0.00518 *8*; α(K)=0.00472 *7*; α(L)=0.000414 *6*; α(M)=5.11×10^{-5} *8*; α(N+..)=2.82×10^{-6} *4* α(N)=2.82×10^{-6} *4* I_γ: from the adopted Iγ(166γ)/Iγ(530γ) and Iγ(530γ).
364 *1*	5.7 *13*	376.50	3/2$^-$	12.40	3/2$^+$	(E1(+M2))	−0.01 *8*	5.09×10^{-4} *18*		%ce(K)<2×10^{-5} α=5.09×10^{-4} *18*; α(K)=0.000463 *17*; α(L)=4.07×10^{-5} *15*; α(M)=5.04×10^{-6} *19*; α(N+..)=2.81×10^{-7} *10* α(N)=2.81×10^{-7} *10*
(377.1[&] *4*)	0.52 *12*	376.50	3/2$^-$	0	7/2$^-$	E2(+M3)	−0.01 *2*	0.00198 *3*		α=0.00198 *3*; α(K)=0.00180 *3*; α(L)=0.0001595 *24*; α(M)=1.97×10^{-5} *3*; α(N+..)=1.086×10^{-6} *16* α(N)=1.086×10^{-6} *16* I_γ: from the adopted Iγ(377γ)/Iγ(364γ) and Iγ(364γ).
425 *1*	13.7 *20*	1662.0	9/2$^-$	1236.70	11/2$^-$	(M1(+E2))	−0.03 *13*	4.73×10^{-4} *22*		α=4.73×10^{-4} *22*; α(K)=0.000430 *20*; α(L)=3.80×10^{-5} *17*; α(M)=4.71×10^{-6} *21*;

γ(^{45}Sc) (continued)

E_γ [†]	I_γ [†a]	E_i(level)	J^π_i	E_f	J^π_f	Mult. [‡]	δ [‡]	α [‡]	Comments
									α(N+..)=2.63×10^{-7} *12* α(N)=2.63×10^{-7} *12*
432	1.4 *8*	974.38	7/2$^+$	543.06	5/2$^+$	M1+E2	−0.24 *+12−16*	0.00050 *7*	α=0.00050 *7*; α(K)=0.00045 *6*; α(L)=4.0×10^{-5} *6*; α(M)=5.0×10^{-6} *7*; α(N+..)=2.8×10^{-7} *4* α(N)=2.8×10^{-7} *4*
530 *1*	1.1 *4*	543.06	5/2$^+$	12.40	3/2$^+$	M1+E2	−0.55 *+11−18*	0.00037 *4*	α=0.00037 *4*; α(K)=0.00034 *4*; α(L)=3.0×10^{-5} *4*; α(M)=3.7×10^{-6} *4*; α(N+..)=2.05×10^{-7} *22* α(N)=2.05×10^{-7} *22*
543 *1*	0.9 *4*	543.06	5/2$^+$	0	7/2$^-$	E1(+M2)	<0.014	0.0001770 *25*	%ce(K)<8×10^{-6} α=0.0001770 *25*; α(K)=0.0001614 *23*; α(L)=1.416×10^{-5} *20*; α(M)=1.754×10^{-6} *25* α(N+..)=9.81×10^{-8} *14* α(N)=9.81×10^{-8} *14*
(688.9[&] *5*)	6.3 *12*	1408.27	(7/2)$^-$	720.12	5/2$^-$	D,E2			I_γ: from adopted Iγ(689γ)/Iγ(1408γ) and Iγ(1408γ).
(708.2[&])	5.1 *10*	720.12	5/2$^-$	12.40	3/2$^+$	(E1(+M2))	<0.024	9.48×10^{-5} *14*	α=9.48×10^{-5} *14*; α(K)=8.63×10^{-5} *13*; α(L)=7.56×10^{-6} *11*; α(M)=9.37×10^{-7} *14*; α(N+..)=5.25×10^{-8} *8* α(N)=5.25×10^{-8} *8* I_γ: from the adopted Iγ(708γ)/I(γ+ce)(720γ) and Iγ(720γ).
719.6 *3*	154 *12*	720.12	5/2$^-$	0	7/2$^-$	M1+E2	+0.14 *5*	1.54×10^{-4} *3*	α(K)exp=0.00020 *6* (1966Po04); %ce(K)=3.0×10^{-5} *4* α=1.54×10^{-4} *3*; α(K)=0.0001404 *25*; α(L)=1.234×10^{-5} *22*; α(M)=1.53×10^{-6} *3*; α(N+..)=8.59×10^{-8} *15* α(N)=8.59×10^{-8} *15*
(942.0[&] *6*)	5.7 *33*	1662.0	9/2$^-$	720.12	5/2$^-$	(E2)		0.0001230 *18*	α=0.0001230 *18*; α(K)=0.0001117 *16*; α(L)=9.82×10^{-6} *14*; α(M)=1.217×10^{-6} *18* α(N+..)=6.81×10^{-8} *10* α(N)=6.81×10^{-8} *10* I_γ: from adopted Iγ(942γ)/Iγ(1661γ) and Iγ(1662γ).
961.6 *6*	3.0 *4*	974.38	7/2$^+$	12.40	3/2$^+$	E2		0.0001170 *17*	α=0.0001170 *17*; α(K)=0.0001060 *15*; α(L)=9.31×10^{-6} *13*; α(M)=1.154×10^{-6} *17* α(N+..)=6.46×10^{-8} *9* α(N)=6.46×10^{-8} *9*
974.0 *5*	5.8 *7*	974.38	7/2$^+$	0	7/2$^-$	E1+M2	<0.042	4.86×10^{-5} *7*	α=4.86×10^{-5} *7*; α(K)=4.43×10^{-5} *7*; α(L)=3.87×10^{-6} *6*; α(M)=4.80×10^{-7} *7*; α(N+..)=2.70×10^{-8} *4* α(N)=2.70×10^{-8} *4*

^{45}Ti ε decay 1971Zu01,1966Po04 (continued)

$\gamma(^{45}Sc)$ (continued)

E_γ[†]	I_γ[†a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	δ[‡]	α[‡]	Comments
1032.1 *5*	4.8 *6*	1408.27	(7/2)$^-$	376.50	3/2$^-$	(E2)		9.80×10^{-5} *14*	$\alpha=9.80\times10^{-5}$ *14*; α(K)=8.92×10^{-5} *13*; α(L)=7.83×10^{-6} *11*; α(M)=9.70×10^{-7} *14*; α(N+..)=5.43×10^{-8} *8* α(N)=5.43×10^{-8} *8*
1236.5 *5*	11.8 *13*	1236.70	11/2$^-$	0	7/2$^-$	E2		8.00×10^{-5} *12*	$\alpha=8.00\times10^{-5}$ *12*; α(K)=5.86×10^{-5} *9*; α(L)=5.14×10^{-6} *8*; α(M)=6.37×10^{-7} *9*; α(N+..)=1.558×10^{-5} *23* α(N)=3.58×10^{-8} *5*; α(IPF)=1.554×10^{-5} *22*
1408.1 *3*	85 *9*	1408.27	(7/2)$^-$	0	7/2$^-$	M1+E2	−2.62 *62*	1.03×10^{-4} *2*	α(K)exp=4.7×10^{-5} *14* (1966Po04); %ce(K)=5.3×10^{-6} *7* $\alpha=1.03\times10^{-4}$ *2*; α(K)=4.35×10^{-5} *8*; α(L)=3.81×10^{-6} *7*; α(M)=4.72×10^{-7} *9*; α(N+..)=5.51×10^{-5} *14* α(N)=2.65×10^{-8} *5*; α(IPF)=5.51×10^{-5} *14*
1660.9 *3*	40.7 *43*	1662.0	9/2$^-$	0	7/2$^-$	M1+E2	−0.47 *5*	1.57×10^{-4} *3*	$\alpha=1.57\times10^{-4}$ *3*; α(K)=2.88×10^{-5} *5*; α(L)=2.52×10^{-6} *4*; α(M)=3.13×10^{-7} *5*; α(N+..)=0.0001249 *22* α(N)=1.76×10^{-8} *3*; α(IPF)=0.0001249 *22*
1789[@b]	0.057[@] *10*	1800.0?	5/2$^+$	12.40	3/2$^+$	D+Q			
1801[@b]	0.041[@] *9*	1800.0?	5/2$^+$	0	7/2$^-$	(E1)		0.000512 *8*	α=0.000512 *8*; α(K)=1.539×10^{-5} *22*; α(L)=1.344×10^{-6} *19*; α(M)=1.666×10^{-7} *24* α(N+..)=0.000495 *7* α(N)=9.38×10^{-9} *14*; α(IPF)=0.000495 *7*

[†] From 1971Zu01, except as noted.
[‡] From the ^{45}Sc Adopted Gammas.
[#] From 1966Po04.
[@] From 1986Bo06. Iγ(1789γ)=1.4×10^{-3} *2* and Iγ(1801γ)=1.0×10^{-3} *2* relative to Iγ(1661γ)=100. Note that Iγ(1801γ)/Iγ(1789γ)=0.71 *18* is not consistent with the adopted value of 0.221 *23*.
[&] From the ^{45}Sc Adopted Gammas.
[a] For absolute intensity per 100 decays, multiply by 1.0×10^{-3}.
[b] Placement of transition in the level scheme is uncertain.

$^{45}_{21}Sc_{24}$-5

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Decay Scheme

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