^{44}Ti ε decay (59.1 y) 1991We08,1990Sc08,1988Al27

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen and Balraj Singh	NDS 190,1 (2023)	20-Jun-2023

Parent: ^{44}Ti: E=0.0; $J^\pi=0^+$; $T_{1/2}$=59.1 y *3*; Q(ε)=267.4 *19*; %ε decay=100

^{44}Ti-$T_{1/2}$: From ^{44}Ti Adopted Levels.

^{44}Ti-Q(ε): From 2021Wa16.

1991We08: experiment performed at the Brookhaven National Laboratory. A LEPS-type Ge detector for detecting γ-rays. Measured Eγ, Iγ. Deduced high precision transition energies.

1990Sc08: measured γ-emission rate. Deduced photo emission probabilities. Ge(Li) detectors.

1988Al27: ^{44}Ti activity produced by the ^{45}Sc(p,2n) reaction at the Brookhaven National Laboratory. Measured Eγ, Iγ, γγ-coin. Deduced levels, branchings, $T_{1/2}$ using delayed coincidence method. LEPS detector and Ge(Li) detectors.

1967Ri06: measurement performed at the Brookhaven National Laboratory. Measured Eγ, Iγ, γγ-correlation, Xγ-coin. Deduced levels, γ-branchings, internal conversion coefficients, $T_{1/2}$ using delayed coincidence method.

1963Kl06: ^{44}Ti activity produced by the ^{45}Sc(d,3n) reaction. Measurement performed at the University of Colorado. Measured Eγ, Iγ, γγ-coin. Deduced levels, γ-branchings, conversion coefficients, $T_{1/2}$ using delayed coincidence method.

2007Dr05: measured Eγ, Iγ, γγ-coin. Deduced conversion coefficients and penetration parameter.

Others:

$T_{1/2}$ of ^{44}Ti: 2006Ah10, 2001Ha21, 2000Go15, 1999Wi01, 1998Ah03, 1998Go05, 1998No06, 1997No06, 1996Me22, 1990Al11, 1983Fr27, 1965Mo07, 1965Wi05.

$T_{1/2}$ and isotopic assignment: 1954Sh30, 1957Hu90, 1959Cy90.

γ: 1973Gr28, 1959Cy90, 1957Hu90.

γγ(θ): 1968Gl02, 1962Th12.

γγ(t): 1975Gu24.

γγ(θ,t): 1971Ha38, 1973Ha61, 1974Co20, 1974Re12, 1974Si09.

Preparation of ^{44}Ti radioactive target: 1999La11.

The total average radiation energy of 268 keV 4 (which includes all the radiations emitted by ^{44}Ti), calculated with the computer program RADLST, agrees very well with Q(ε)=267.4 keV *19* (2021Wa16) and confirms the quality and completeness of the ^{44}Ti decay scheme.

^{44}Sc Levels

E(level)†	J^π‡	$T_{1/2}$‡	Comments
0.0	2^+	4.0420 h *25*	
67.8680 *14*	1^-	154.8 ns *8*	$T_{1/2}$: weighted average of 155.6 ns *7* (1988Al27), 155 ns *2* (1975Gu24), 166 ns *5* (1963Kl06), 153 ns *2* (1967Ri06), 153 ns *1* (1962Th12), 180 ns *20* (1959Cy90).
146.1915 *20*	0^-	51.0 μs *3*	$T_{1/2}$: weighted average of 51.1 μs *3* (1988Al27), 49.5 μs *10* (1964Br27), 50 μs *3* (1963Kl06).

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

‡ From the Adopted Levels. For excited states, adopted values are from this dataset, as noted under comments.

ε radiations

Subshell ratios are theoretical values from 1998Sc28.

The log *ft* systematic trend of second-forbidden transitions suggests log *ft*>10.6 (1998Si17) for the 0^+ to 2^+ ε transition to ^{44}Sc ground state. This limit corresponds to Iε<0.04%.

E(decay)	E(level)	Iε†‡	Log *ft*	Comments
(121.2 *19*)	146.1915	99.8 *+2−17*	6.497 *+8−1*	εK=0.8812 *8*; εL=0.1022 *6*; εM+=0.01664 *24* Iε: from I(γ+ce)(78.4)+I(γ+ce)(146).

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ε radiations (continued)

E(decay)	E(level)	Iε[†‡]	Log *ft*	Comments
(199.5 *19*)	67.8680	<1.9	>8.7	εK=0.8839 *7*; εL=0.0999 *5*; εM+=0.01621 *22* Iε: from 100-I(ε to 146 level)=0.2 *+17−2*. Others: 0.7 *3*, from a measurement of the 68- and 78-keV γ rays in delayed coincidence with 4-keV x-rays from electron capture (1988Al27); 1.9 *15* (1967Ri06); 1.2 *19* from γ+ce intensity balance.

† From γ+ce intensity balance at each level, unless otherwise noted.
‡ Absolute intensity per 100 decays.

γ(^{44}Sc)

Iγ normalization: weighted average of 0.959 *15* deduced by the evaluators from ΣI(γ+ce to g.s.)=100 and 0.974 *13* deduced by 1990Sc08 from Iγ(78.3γ) relative to that of the 1157-keV transition with %Iγ=0.999 *1* in the decay of ^{44}Sc in equilibrium with ^{44}Ti.

E_γ[†]	I_γ[#]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	α[@]	Comments
67.8679 *14*	96.1 *15*	67.8680	1^-	0.0	2^+	E1	0.0846 *12*	α(K)=0.0770 *11*; α(L)=0.00676 *9*; α(M)=0.000831 *12* α(N)=4.47×10^{-5} *6* %Iγ=93.0 *19* E_γ: others: 67.875 *5* (1988Al27), 67.85 *4* (1967Ri06), 67.85 *7* (1963Kl06). I_γ: weighted average (LWM) of 94.2 *15* (1967Ri06), 98.1 *15*(1988Al27), and 96.0 *15* (1990Sc08). Original uncertainty of 0.5 (1967Ri06) seemed unrealistically low. Evaluators increased it to 1.5. Mult.: from α(K)exp=0.123 *23* (1967Ri06); α(exp)=0.10 *5* (1963Kl06). α(exp)=0.069 *11*, deduced by evaluator from decay scheme by using %Iγ(67.9)=93.5% *15* (1990Sc08), and neglecting the very weak 146-keV transition. α(exp)=0.069 *11* disagrees with a theoretical value of 0.0845 *25* (1976Ba63).
78.3234 *14*	100.0 *11*	146.1915	0^-	67.8680	1^-	M1	0.0302 *4*	α(K)=0.0274 *4*; α(L)=0.002486 *35*; α(M)=0.000308 *4* α(N)=1.684×10^{-5} *24* %Iγ=96.8 *17* E_γ: others: 78.337 *3* (1988Al27), 78.38 *4* (1967Ri06), 78.44 *7* (1963Kl06). I_γ: weighted average (LWM) of 100.0 *11* (1967Ri06), 100.0 *11* (1988Al27), and 100.0 *13* (1990Sc08). Original uncertainty of 0.5 (1967Ri06) seemed unrealistically low. Evaluators increased it to 1.1. Mult.: from α(K)exp=0.031 *5* (1967Ri06); α(exp)=0.017 *8* (1963Kl06). α(exp)=0.019 *14*, deduced by evaluator from decay scheme by using %Iγ(78.4)=97.4% *13* (1990Sc08), Iε(to 67.9 level)=0.7% *3* (1988Al27), and neglecting the very weak 146-keV transition. α(exp)=0.019 *14* disagrees with a theoretical value of 0.0302 *9* (1976Ba63).

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$\gamma(^{44}Sc)$ (continued)

E_γ †	I_γ #	E_i(level)	J^π_i	E_f	J^π_f	Mult. ‡	α @	Comments
146.22	0.095 *3*	146.1915	0^-	0.0	2^+	[M2]	0.0459 *6*	α(K)=0.0415 *6*; α(L)=0.00391 *5*; α(M)=0.000483 *7* α(N)=2.61×10^{-5} *4* %Iγ=0.092 *3* E_γ: from level energy difference. Other: 147 *15* (1967Ri06). I_γ: weighted average (LWM) of 0.10 *3* (1967Ri06), 0.093 *6* (1988Al27), and 0.095 *3* (1990Sc08).

† From 1991We08, unless otherwise specified.

‡ From ce data in 1963Kl06. The same assignments are adopted in Adopted Gammas.

For absolute intensity per 100 decays, multiply by 0.968 *13*.

@ 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.

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Decay Scheme

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