^{44}Sc ε decay (3.97 h) 1976Co06,1983Gu11,1973Si05

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen, Balraj Singh and John A. Cameron	NDS 112, 2357 (2011)	31-Jul-2011

Parent: ^{44}Sc: E=0.0; J$^{\pi}$=2^{+}; $T_{1/2}$=3.97 h *4*; Q(ε)=3652.5 *18*; %ε+%β^{+} decay=100.0

^{44}Sc-Q(ε): From 2011AuZZ. 2003Au03 give 3652.4 *18*.

1976Co06: Source of ^{44}Sr prepared by the (γ,n) reactions on natural Sc at the Livermore linear accelerator or by the (α,dxn) reaction on natural Ca metal at the Berkeley 88-inch cyclotron. Ge(Li) detector. Measured Eγ, Iγ. Deduced levels, γ-branchings, log *ft*.

1983Gu11: Ge(Li) detectors. Measured Eγ, Iγ. Deduced levels, Iβ.

1973Si05: Activity of ^{44}Sc from a ^{44}Ti source deposited on thin mylar in a spot of 0.3 cm diameter. A 25 cm^{3} and a 70 cm^{3} Ge(Li) detectors for detecting γ-rays. Measured Eγ, Iγ, $\gamma\gamma$-coin. Deduced levels, branching ratios.

1990Me15: Measured Eγ, Iγ. Deduced levels.

Other main references: 1990Sc08, 1974HeYW.

Evaluated by E. Browne (LBNL), February 1999. Some revisions and updates were done by the present evaluators.

Additional information 1.

The evaluator applied the Limitation of Relative Statistical Weights (LWM) method (1988WoZO) for averaging numbers throughout this evaluation. To avoid overestimating precision because of possible data correlation, the uncertainty assigned to the average was always equal to or greater than the smallest uncertainty of the values used to calculate the average.

The adopted half-life of ^{44}Sc, 3.97 h *4*, is an average (lwm) of 3.927 h *8* (1969Ra16), 4.00 h *2* (1966Ta01), and 4.05 h *3* (1969Sa34). Others: 3.9 h (1963Di06), 4.04 h (1961Ra06), 4.01 h (1961Kh06), 3.92 h 3 (1945Hi05).

The total average radiation energy of 3653.3 keV 25 (which includes all the radiations emitted by ^{44}Sc), calculated with the computer program RADLST, agrees very well with Q(ε)=3652.5 keV *18* (2011AuZZ) and confirms the quality and completeness of the ^{44}Sc decay scheme.

Others:

$T_{1/2}$(^{44}Sc): 1954An25, 1950Br52, 1948Wa13, 1945Hi05, 1942Sm01, 1940Wa01.

Isotopic identification: 1937Wa07, 1937Wa04, 1937Wa05, 1937Po04, 1938Bu05, 1938Co01, 1938Ge01, 1939Bo05, 1940Wa01, 1946Bl27, 1950Br52, 1951Ba84, 1954An25, 1954Sh30, 1963Di06, 1963Kl06, 1973Si05.

β^{+}: 1937Ja03, 1942Sm01, 1950Br52, 1950Cu14, 1954La40, 1955Bl23, 1958Ko92.

γ,$\gamma\gamma$: 2006Va23, 1981Yu03, 1973Si05, 1973Gr28, 1972Vo03, 1972Ta36, 1971Ok03, 1970Le05, 1970Ei07, 1968Ki03, 1968Wa21, 1963Di06, 1961Mc03, 1955Bl23, 1950Br52, 1950Cu14.

$\gamma\gamma(\theta)$: 1968Wa21.

$\beta\gamma$(circ pol): 1965Ma06, 1962Ma13, 1962Bl02, 1958Bo90.

ε/β^{+}: 1983Ba41 (also 1976St21).

^{44}Ca Levels

E(level)[‡]	J$^{\pi}$	$T_{1/2}$[†]
0.0	0^{+}	
1157.039 *15*	2^{+}	2.61 ps *14*
2656.530 *24*	2^{+}	30 fs *3*
3301.46 *6*	2^{+}	35 fs *18*
3307.9	3^{-}	

† From 1990En08.

‡ Deduced by evaluator from a least-squares fit to γ-ray energies.

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ε,β^+ radiations

The log *ft* systematic trend of second-forbidden transitions suggests log *ft*>10.6 (1998Si17) for the 2^+ to 0^+ ε transition to ^{44}Ca ground state. This limit corresponds to Iε<0.005%.

E(decay)	E(level)	Iβ^+ ‡	Iε †‡	Log *ft*	I($\varepsilon+\beta^+$) ‡	Comments
(344.6# *18*)	3307.9		0.0011 *3*	7.2 *1*	0.0011 *3*	εK=0.8954 *20*; εL=0.0911 *16*
(351.0 *18*)	3301.46		0.0044 *11*	6.6 *1*	0.0044 *11*	εK=0.8954 *20*; εL=0.0911 *16*
(996.0 *18*)	2656.530		1.02 *2*	5.16 *1*	1.02 *2*	εK=0.8966 *19*; εL=0.0900 *16*
(2495.5 *18*)	1157.039	94.27 *5*	4.70 *5*	5.30	98.97 *2*	av Eβ=632.0 *9*; εK=0.04098 *9*; εL=0.004098 *7* Iβ^+: from ratio ε/β^+=0.0499 *5*, weighted average of 0.0499 *5* (1983Ba41) and 0.0497 *23* (1976St21). From the annihilation radiation intensity of 188 *3* (1990Sc08) one obtains Iβ^+(1157)=94.0% *15* and Iε(1157)=4.97% *15*. These values are consistent with Iβ^+=94.27% *5* and Iε=4.70% *5*, adopted here, but less accurate.

† Subshell ratios are theoretical values from 1998Sc28.
‡ Absolute intensity per 100 decays.
# Existence of this branch is questionable.

$\gamma(^{44}Ca)$

Iγ normalization: assuming no $\varepsilon+\beta^+$ to g.s. and ΣI(γ+ce)(g.s.)=100%.

E$_\gamma$ †	I$_\gamma$ ‡@	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.	δ	α #	Comments
1157.020 *15*	1000 *3*	1157.039	2^+	0.0	0^+	E2		6.48×10^{-5}	α(K)=5.90×10^{-05}; α(L)=4.99×10^{-06}; α(M+..)=8.1×10^{-07} Absolute intensity is 99.875% *3*. Notice that the extremely small uncertainty is due to cancellation effects caused by covariances.
1499.46 *2*	9.09 *15*	2656.530	2^+	1157.039	2^+	M1+E2	−0.123 *16*	3.20×10^{-5}	α(K)=2.91×10^{-05}; α(L)=2.46×10^{-06}; α(M+..)=4.4×10^{-07} δ: weighted average of −0.14 *7* (1966Ma31), −0.15 *7* (1970La09), −0.137 *17* (1968Wa21), and −0.07 *3* (1971Ok03). Value recommended by 1990En08.
2144.3 *1*	0.03 *1*	3301.46	2^+	1157.039	2^+				I$_\gamma$: unweighted average of 0.02 *2* (1976Co06,1990Me15), 0.035 *10* (1983Gu11), and 0.039 *7* (1973Si05). Accurate value is lacking due to large corrections to this peak from single escape of 2656.5γ.

Continued on next page (footnotes at end of table)

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

E_γ [†]	I_γ [‡@]	E_i(level)	J^π_i	E_f	J^π_f	Mult.	Comments
2150.840[&] *22*	0.011 *3*	3307.9	3^-	1157.039	2^+		I_γ: γ ray reported by 1976Co06 (1990Me15) only. Its existence and assignment is considered (evaluator) uncertain due to lack of confirmation in other studies of ^{44}Sc decay. E_γ: from ^{44}K decay (1976Co06,1990Me15).
2656.48 *7*	1.12 *3*	2656.530	2^+	0.0	0^+	E2	
3301.35 *6*	0.014 *5*	3301.46	2^+	0.0	0^+	E2	I_γ: from adopted $I\gamma(2144)/I\gamma(3301)$=2.2 *2* and $I\gamma(2144)$=0.03 *1*. Reported $I\gamma$=0.016 *2* (1983Gu11), 0.0064 *8* (1976Co06,1990Me15), 0.018 *3* (1973Si05).

† Weighted average (LWM) of values from 1990Me15, 1976Co06, 1983Gu11, 1974HeYW, and 1973Si05.

‡ Weighted average (LWM) of values from 1990Me15, 1976Co06, 1990Sc08, 1983Gu11, 1974HeYW, and 1973Si05; unless otherwise stated.

Interpolated theoretical values from 1976Ba63.

@ For absolute intensity per 100 decays, multiply by 9.99×10^{-2} *3*.

& Placement of transition in the level scheme is uncertain.

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Decay Scheme