^{35}Ca $\varepsilon+\beta^+$ decay (25.7 ms) 1999Tr04,1985Ay01

Parent: ^{35}Ca: E=0; J$^\pi$=1/2$^+$; $T_{1/2}$=25.7 ms *2*; Q(ε)=1.595×10^4 *11*; %ε+%β^+ decay=100.0

^{35}Ca-J$^\pi$,$T_{1/2}$: From the Adopted Levels of ^{35}Ca.

^{35}Ca-Q($\varepsilon+\beta^+$): Deduced by evaluators from mass excesses of 4777 *105* for ^{35}Ca measured by 2023La09 and −11172.9 *5* for ^{35}K from 2021Wa16. Q(ε) from 2021Wa16: 16360 *200* (syst).

1999Tr04, 1998Le45: A secondary ^{35}Ca beam at 0.3 ions/s and 98% purity was produced via the projectile fragmentation of a 95-MeV/nucleon ^{40}Ca^{20+} primary beam impinging on a rotating natNi target, selected using ΔE-tof by the GANIL LISE3 spectrometer, and implanted into a 500 μm silicon detector sandwiched between two 500−μm silicon detectors for detecting β^+ particles. 3.5×10^4 ^{35}Ca ions were stopped at a depth of 300 μm with FWHM=70 μm (setting 1) and 2.5×10^4 ^{35}Ca ions were stopped at a depth of 450 μm (setting 2). $\varepsilon+\beta^+$-delayed protons were detected by the implantation detector. γ rays were detected by three Ge detectors and two NaI detectors. Measured E_p, I_p, Eγ, Iγ, E_{2p}, I_{2p}, βp-coin, pγ-coin. Built the decay scheme consisting of 1p-emitting states in ^{35}K, a 2p-emitting state (T=5/2 IAS) in ^{35}K, 1p daughter states in ^{34}Ar, and a 2p daughter state in ^{33}Cl. Deduced decay branching ratios, B(GT) and B(F), and parent ^{35}Ca $T_{1/2}$ from implant-decay correlations.

1985Ay01: ^{35}Ca isotope discovery. ^{35}Ca was produced by bombarding a natural calcium target using a 135-MeV ^{3}He beam from the 88-inch Cyclotron at Lawrence Berkeley Laboratory. Recoiling products were slowed down, transported, and collected on a slowly rotating catcher wheel. The $\varepsilon+\beta^+$-delayed protons were detected using Si detector telescopes. Measured E_p, I_p, pp-coin. Built the decay scheme consisting of a 2p-emitting state (T=5/2 IAS) in ^{35}K, sequential 2p intermediate states in ^{34}Ar, and 2p daughter states in ^{33}Cl. Deduced ^{35}Ca $T_{1/2}$ and ^{35}Ca mass using the known members of A=35, T=5/2 sextuplets IMME.

Theoretical studies involving ^{35}Ca decay: 2003Sm02, 1991De26, 1990Br26.

^{35}K Levels

E(level)[†]	J$^\pi$[#]	$T_{1/2}$[#]	Comments
0	3/2$^+$	175 ms *2*	$T_{1/2}$: weighted average of 175 ms *2* (2018Sa54), 178 ms *8* (1998Sc19), and 190 ms *30* (1980Ew02).
1553 *5*	1/2$^+$		E(p0)$_{lab}$=1427 *5*, proton line 1 in 1999Tr04.
3781 *26*	1/2$^+$,3/2$^+$		E(p0)$_{lab}$=3592 *25*, proton line 5 in 1999Tr04.
4018 *37*	1/2$^+$,3/2$^+$		E(p0)$_{lab}$=3822 *36*, proton line 6 in 1999Tr04.
4520[‡]			E(p1)$_{lab}$=1909-2647, proton group 2 in 1999Tr04, corresponding to E(level)=4140-4900.
4788 *49*	1/2$^+$,3/2$^+$		E(p0)$_{lab}$=4570 *48*, proton line 9 in 1999Tr04.
4982 *13*	1/2$^+$,3/2$^+$		E(p0)$_{lab}$=4754 *38*, proton line 10 in 1999Tr04, corresponding to E(level)=4977 *39*. E(p1)$_{lab}$=2727 *13*, proton line 3 in 1999Tr04, corresponding to E(level)=4982 *13*. E(level): weighted average of the two E(level) values of 4977 *39* (p0) and 4982 *13* (p1).
5249 *73*	1/2$^+$,3/2$^+$		E(p0)$_{lab}$=5018 *71*, proton line 11 in 1999Tr04.
5493[‡]			E(p1)$_{lab}$=2947-3500, proton group 4 in 1999Tr04, corresponding to E(level)=5208-5778.
5533 *49*	1/2$^+$,3/2$^+$		E(p0)$_{lab}$=5294 *48*, proton line 12 in 1999Tr04.
5710 *49*	1/2$^+$,3/2$^+$		E(p0)$_{lab}$=5466 *48*, proton line 13 in 1999Tr04.
5716[‡]			E(p2)$_{lab}$=1909-2647, proton group 2 in 1999Tr04, corresponding to E(level)=5336-6096.
5865 *38*	1/2$^+$,3/2$^+$		E(p0)$_{lab}$=5616 *37*, proton line 14 in 1999Tr04.
6089 *62*	1/2$^+$,3/2$^+$		E(p0)$_{lab}$=5834 *60*, proton line 15 in 1999Tr04.
6302[‡]			E(p3)$_{lab}$=1909-2647, proton group 2 in 1999Tr04, corresponding to E(level)=5922-6681.
6335 *73*	1/2$^+$,3/2$^+$		E(p1)$_{lab}$=4041 *71*, proton line 7 in 1999Tr04.
6585[‡]			E(p0)$_{lab}$=5983-6649, proton group 16 in 1999Tr04, corresponding to E(level)=6243-6928.
7813[‡]			E(p0)$_{lab}$=7131-7887, proton group 18 in 1999Tr04, corresponding to E(level)=7424-8203.
9168 *23*	1/2$^+$		T=5/2 E(p0)$_{lab}$=8802 *89*, proton line 19 in 1999Tr04, corresponding to E(level)=9144 *92*. E(p1)$_{lab}$=6783 *22*, proton line 17 in 1999Tr04, corresponding to E(level)=9157 *23*. E(2p0)$_{lab}$=4305 *26*, proton line 8 in 1999Tr04, corresponding to E(level)=9186 *27* with S(2p)(^{35}K)=4747.5 *6* (2021Wa16) and adding a +7−keV correction for the difference in the recoil effect between 1p and 2p emissions (1999Tr04). E(level): weighted average of the three E(level) values of 9144 *92* (p0), 9157 *23* (p1), and 9186 *27* (2p0). Other: E(2p0)$_{lab}$=4089 *30*, E(2p0)$_{c.m.}$=4311 *40* (1985Ay01), corresponding to E(level)=9059 *41* in ^{35}K with S(2p)(^{35}K)=4747.5 *6* (2021Wa16). 1985Ay01 also observed E(2p1)$_{lab}$=3287 *30* and proposed both 2p0 and 2p1 proceed via a sequential

Continued on next page (footnotes at end of table)

^{35}Ca $\varepsilon+\beta^+$ decay (25.7 ms) 1999Tr04,1985Ay01 (continued)

^{35}K Levels (continued)

E(level)†	J^π#	$T_{1/2}$#	Comments
			decay mechanism with the first proton $E(p)_{lab}$=2213 keV, corresponding to an intermediate state in ^{34}Ar at 6807 keV. 2p1 has been ruled out in 1999Tr04 due to the nonobservation of expected pγ coincidences. 1999Tr04 also states that the observed ratio I(2p0)/I(p)=0.98 *9* agrees with the calculated branching ratio I(2p)/I(p)=1 for the IAS (1991De26).

† Evaluators deduced E(level)(^{35}K)=$E(p)_{lab}$×[m(p)+m(^{34}Ar)]/m(^{34}Ar)+S(p)(^{35}K)+E(level)(^{34}Ar), with S(p)(^{35}K)=83.6 *5* (2021Wa16), E(level)(^{34}Ar) from 2012Ni10, and $E(p)_{lab}$ from 1999Tr04. For a ^{35}K proton-emitting level with multiple proton branches, evaluators take the weighted average for E(level)(^{35}K) values deduced from each proton branch. 1999Tr04 used S(p)(^{35}K)=78 *20* from 1993Au07, which causes a small difference between the original E(level)(^{35}K) in 1999Tr04 and the deduced E(level)(^{35}K) here.

‡ Unresolved proton-emitting levels corresponding to a group of unresolved protons populating one daughter state in ^{34}Ar, which are not included in the Adopted Levels.

\# From the Adopted Levels.

ε,β^+ radiations

E(decay)	E(level)	$I\beta^+$ #	$I\varepsilon$#	Log *ft*	$I(\varepsilon+\beta^+)$†#	Comments
(6.78×10^3 *11*)	9168	8.4 *4*	0.0056 *9*	3.3 *1*	8.4 *4*	$I(\varepsilon+\beta^+)$: %I(p0)=0.41 *6*, %I(p1)=3.8 *2*, %I(2p0)=4.2 *3*.
(8.14×10^3 *11*)	7813	1.1 *2*	4.0×10^{-4} *9*	4.6	1.1‡ *2*	
(9.37×10^3 *11*)	6585	1.09 *17*	2.5×10^{-4} *5*	4.9	1.09‡ *17*	
(9.62×10^3 *13*)	6335	2.9 *3*	6.1×10^{-4} *10*	4.6 *1*	2.9 *3*	
(9.65×10^3 *11*)	6302	2.0 *7*	4×10^{-4} *2*	4.7	2.0‡ *7*	
(9.86×10^3 *13*)	6089	1.40 *19*	2.7×10^{-4} *5*	4.9 *1*	1.40 *19*	
(1.009×10^4 *12*)	5865	1.43 *17*	2.6×10^{-4} *5*	5.0 *1*	1.43 *17*	
(1.023×10^4 *11*)	5716	1.0 *4*	1.7×10^{-4} *7*	5.2	1.0‡ *4*	
(1.024×10^4 *12*)	5710	0.61 *15*	1.1×10^{-4} *3*	5.4 *+2−1*	0.61 *15*	
(1.042×10^4 *12*)	5533	0.72 *18*	1.2×10^{-4} *3*	5.4 *+2−1*	0.72 *18*	
(1.046×10^4 *11*)	5493	2.2 *3*	3.6×10^{-4} *7*	4.9	2.2‡ *3*	
(1.070×10^4 *13*)	5249	3.9 *3*	5.9×10^{-4} *9*	4.7 *1*	3.9 *3*	
(1.097×10^4 *11*)	4982	10.2 *7*	0.0014 *2*	4.32 *6*	10.2 *7*	$I(\varepsilon+\beta^+)$: %I(p0)=4.2 *4*, %I(p1)=6.0 *5*.
(1.116×10^4 *12*)	4788	2.9 *3*	3.8×10^{-4} *6*	4.9 *1*	2.9 *3*	
(1.143×10^4 *11*)	4520	5.4 *9*	7×10^{-4} *2*	4.7	5.4‡ *9*	
(1.193×10^4 *12*)	4018	3.8 *3*	4.1×10^{-4} *6*	4.9 *1*	3.8 *3*	
(1.217×10^4 *11*)	3781	3.0 *3*	3.0×10^{-4} *5*	5.1 *1*	3.0 *3*	
(1.440×10^4 *11*)	1553	48.5 *13*	0.0030 *4*	4.26 *3*	48.5 *13*	

† From I(p) obtained from the number of observed proton events and the total number of implants, with simulated proton-detection efficiencies (1999Tr04).

‡ Feeding to a group of unresolved levels in ^{35}K.

\# Absolute intensity per 100 decays.