

^{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; $Q(\varepsilon+\beta^+)=1.595\times10^4$ 11; $\% \varepsilon+\beta^+$ decay=100.0

^{35}Ca - J^π , $T_{1/2}$: 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. $Q(\varepsilon)$ 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 $^{40}\text{Ca}^{20+}$ 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 , E_γ , I_γ , E_{2p} , I_{2p} , βp -coin, γp -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, $B(\text{GT})$ and $B(\text{F})$, 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 ^3He 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 , βp -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.

The decay scheme is considered relatively complete as all observed individual I(1p) and I(2p) add up to almost 100% in 1999Tr04.

 ^{35}K Levels

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

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

<u>E(level)[†]</u>	<u>J^π[#]</u>	<u>T_{1/2}[#]</u>	Comments
			observed E(2p1) _{lab} =3287 30 and proposed both 2p0 and 2p1 proceed via a sequential 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 py 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

<u>E(decay)</u>	<u>E(level)</u>	<u>Iβ^+ [#]</u>	<u>Iε [#]</u>	<u>Log <i>ft</i></u>	<u>I($\varepsilon+\beta^+$)^{†#}</u>	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	1.08 17	2.5×10 ⁻⁴ 5	4.9	1.08 [‡] 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	1.39 19	2.7×10 ⁻⁴ 5	4.9 1	1.39 19	
(1.009×10 ⁴ 12)	5865	1.42 17	2.6×10 ⁻⁴ 5	5.0 1	1.42 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	10.1 7	0.0014 2	4.32 6	10.1 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	48.2 13	0.0030 4	4.26 3	48.2 13	

[†] Deduced from the I(p) values in **1999Tr04** multiplied by 0.994. The original %ΣI(1p)=96.4 18 and %ΣI(2p)=4.2 3 in **1999Tr04** lead to %ΣI(1p)+%ΣI(2p)=100.6. The evaluators perform a renormalization of 100.6 to 100, which yields the factor of 0.994.

The original I(p) in **1999Tr04** was determined from the number of observed proton events and the total number of implants, with simulated proton-detection efficiencies.

[‡] Feeding to a group of unresolved levels in ^{35}K . The corresponding Log *ft* values are displayed without uncertainties.

[#] Absolute intensity per 100 decays.