

^{35}K $\varepsilon+\beta^+$ decay (175 ms) 1980Ew02

Parent: ^{35}K : $E=0$; $J^\pi=3/2^+$; $T_{1/2}=175$ ms 2; $Q(\varepsilon)=11874.4$ 9; $\% \varepsilon + \% \beta^+$ decay=100.0

^{35}K - J^π , $T_{1/2}$: From the Adopted Levels of ^{35}K .

^{35}K - $T_{1/2}$: Weighted average of 175 ms 2 (2018Sa54), 178 ms 8 (1998Sc19), and 190 ms 30 (1980Ew02).

^{35}K - $Q(\varepsilon)$: From 2021Wa16.

^{35}K - $\%(\varepsilon+\beta^+)$: $p=0.37$ 15 for $E(p)>0.9$ MeV (1980Ew02). $E(p)<0.9$ MeV has also been observed (2018Sa54, 2019ChZU).

1980Ew02, 1979Ca15: A 600-MeV proton beam was produced from the synchrocyclotron at CERN-ISOLDE and bombard a ScC_2 target. The $^{45}\text{Sc}(p, 8n3p)$ spallation reaction products diffused out of the target and reached a tungsten surface ionization source where potassium isotopes were selectively ionized. The beam was extracted from the ion source, separated by the ISOLDE analyzing magnet, and collected by a mylar foil for γ -ray measurements and then a carbon foil for proton measurements. γ rays were detected using a $\text{Ge}(\text{Li})$ detector. Time for positron activities were determined using a 700- μm thick silicon detector. Protons were detected using a 20- μm -700- μm thick ΔE -E telescope of silicon surface barrier detectors with FWHM=50 keV. Measured $E_\gamma(<5$ MeV), I_γ , $E_p(>0.9$ MeV), I_p . Deduced levels, J , π , decay branching ratios, $\log ft$, parent ^{35}K $T_{1/2}$, and coefficients of the isobaric multiplet mass equation for $A=36$, $T=2$ quartets. Comparisons with shell-model calculations and the mirror nucleus ^{35}Cl . Also see abstracts 1978HaYH, 1979HaZY, 1979HaZT, and 1979AnZZ.

2018Sa54: A 36-MeV/nucleon ^{36}Ar primary beam was produced from the K500 cyclotron at Texas A&M University. The secondary ^{35}K beam was produced via the $^1\text{H}(^{36}\text{Ar}, ^{35}\text{K})2n$ reaction of ^{36}Ar bombarding a LN_2 -cooled hydrogen gas target, separated by MARS, and implanted into a 45- μm DSSD sandwiched between a 140- μm SSSD and a 1-mm Si-pad detector in a pulsed-beam mode. $\varepsilon+\beta^+$ -delayed protons were detected by the implantation detector. γ rays were detected by two HPGe detectors. Measured $E_p(>300$ keV), I_p , E_γ , I_γ , $p\gamma$ -coin, $\gamma\gamma$ -coin. Deduced parent ^{35}K $T_{1/2}$.

2019ChZU: Same beam production as 2018Sa54. ^{35}K was implanted into the AstroBox2 detector filled with 800-Torr P5 gas. $\varepsilon+\beta^+$ -delayed protons were detected by the implantation detector. γ rays were detected by 4 Clover Ge detectors. Measured $E_p(>100$ keV), I_p , E_γ , I_γ , $p\gamma$ -coin, $\gamma\gamma$ -coin.

1998Sc19: A polarized ^{35}K beam was produced via the fragmentation of 500-MeV/nucleon ^{40}Ca impinging on a ^9Be target at GSI, separated using ΔE -tof by FRS, momentum-selected by slits, and implanted into a KBr single crystal placed in the central region of a magnet. Positrons were detected using plastic scintillators. γ rays were detected using a Ge detector. Measured β -decay asymmetry and $\beta\gamma$ -coin. Deduced polarization and g -factor of ^{35}K ground state from β -NMR and ^{35}K $T_{1/2}$ from $\beta\gamma$ -decay time spectra.

2006Me04: A polarized ^{35}K beam was produced via the proton-pickup reaction $^{36}\text{Ar}(^9\text{Be}, ^{10}\text{Li})^{35}\text{K}$, separated by NSCL-A1900, and implanted into a KBr crystal. Positrons were detected using plastic scintillators. Deduced the magnetic dipole moment and g -factor of ^{35}K ground state from β -NMR.

Theoretical studies involving ^{35}K decay: shell model (1985Br29, 2003Sm02).

 ^{35}Ar Levels

$E(\text{level})^\dagger$	J^π^\ddagger	$T_{1/2}$	Comments
0	$3/2^+$	1.7756 s 14	
1184.01 25	$1/2^+$		
1750.72 25	$(5/2)^+$		
2637.99 26	$3/2^+$		
2982.79 12	$5/2^+$		
4065.0? 4	$(1/2^+, 3/2^+, 5/2^+)$		
4528.2 4	$(1/2^+, 3/2^+, 5/2^+)$		
4725.9 6	$1/2^+$		
4785.8 11	$1/2^+, 3/2^+, 5/2^+$		
5572.66 15	$3/2^+$		$T=3/2$
6348 11	$(1/2, 3/2, 5/2)$		$E(p0)_{\text{c.m.}}=452$ keV 11 (2019ChZU).
7053 11	$3/2^+, 5/2^+$		$E(p0)_{\text{c.m.}}=1157$ keV 11 (2019ChZU).
7255 11			$E(p3)_{\text{c.m.}}=693$ keV 11 (2019ChZU).
7283 11			$E(p0)_{\text{c.m.}}=1387$ keV 11 (2019ChZU).
7431 11			$E(p3)_{\text{c.m.}}=869$ keV 11 (2019ChZU).
7518 11	$1/2^+, 3/2^+, 5/2^+$		$E(\text{level})$: weighted average of $E(\text{level})$ of 7497 20, 7510 20, and 7527 11. The former two $E(\text{level})$ are deduced from $E(p0)_{\text{c.m.}}=1601$ 20 (1980Ew02) and $E(p1)_{\text{c.m.}}=1467$ 20 (1980Ew02), respectively, with the corresponding $E(\text{level})(^{34}\text{Cl})$ (2012Ni10) and $S(p)(^{35}\text{Ar})=5896.2$ 7 (2021Wa16). The 7527 11

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^{35}K $\varepsilon+\beta^+$ decay (175 ms) **1980Ew02** (continued) ^{35}Ar Levels (continued)

$E(\text{level})^\dagger$	J^π^\ddagger	Comments
8393? 20	$1/2^+, 3/2^+, 5/2^+$	is from 2019ChZU with $E(p3)_{\text{c.m.}}=965$ 11. $E(\text{level})$: weighted average of $E(\text{level})$ of 8392 20, 8392 20, and 8395 20, deduced from $E(p0)_{\text{c.m.}}=2496$ 20 (1980Ew02), $E(p1)_{\text{c.m.}}=2349$ 20 (1980Ew02), and $E(p2)_{\text{c.m.}}=2038$ 20 (1980Ew02), respectively, with the corresponding $E(\text{level})(^{34}\text{Cl})$ (2012Ni10) and $S(p)(^{35}\text{Ar})=5896.2$ 7 (2021Wa16).

† From a least-squares fit to γ -ray energies in **1980Ew02** for levels connected with γ transitions.

‡ From the Adopted Levels.

 ε, β^+ radiations

$E(\text{decay})$	$E(\text{level})$	$I\beta^+^\dagger$	$I\varepsilon^\dagger$	$\text{Log } ft$	$I(\varepsilon+\beta^+)^\dagger$	Comments
(3481 20)	8393?	0.062 26	4.3×10^{-4} 18	$4.6 +3-2$	0.062 26	$I(\varepsilon+\beta^+)$: 0.062 26 $I(p0+p1+p2)$ from Table 3 of 1980Ew02 .
(4356 11)	7518	>0.090	$>3 \times 10^{-4}$	<5.0	>0.09	$I(\varepsilon+\beta^+)$: 0.15 6 $I(p0+p1)$ from Table 3 of 1980Ew02 . Evaluators adopted a lower limit due to unreported $I(p3)$ (2019ChZU).
(5526 11)	6348	0.0025 5	2.9×10^{-6} 6	7.2 1	2.5×10^{-3} 5	
(6301.7 14)	5572.66	36.3 24	0.0265 18	3.31 4	36.3 24	
(7088.6 18)	4785.8	1.0 4	5×10^{-4} 2	5.2 2	1.0 4	
(7148.5 15)	4725.9	2.1 4	0.0010 2	4.9 1	2.1 4	
(7346.2 14)	4528.2	0.7 4	3×10^{-4} 2	$5.4 +4-2$	0.7 4	
(7809.4 14)	4065.0?	0.56 33	2.0×10^{-4} 12	$5.6 +4-2$	0.56 33	
(8891.6 14)	2982.79	26.0 22	0.0060 5	4.27 4	26.0 22	
(9236.4 14)	2637.99	≤ 0.4		≥ 6.2	≤ 0.4	
(10123.7 14)	1750.72	11.9 9	0.00181 14	4.91 4	11.9 9	
(10690.4 14)	1184.01	2.2 7	2.8×10^{-4} 9	$5.8 +2-1$	2.2 7	
(11874.4 17)	0	19 4	0.0018 4	5.1 1	19 4	$I(\varepsilon+\beta^+)$: From 1980Ew02 assuming mirror $\log ft$ with a small asymmetry correction.

† Absolute intensity per 100 decays.

 $\gamma(^{35}\text{Ar})$

I_γ normalization: From $\Sigma\%I_\gamma(\gamma \text{ to g.s.})=80.6$ 40, deduced from $100-\%(\varepsilon+\beta^+)p-\%I(\varepsilon+\beta^+)(\text{g.s.})$, where $\%(\varepsilon+\beta^+)p=0.37$ 15 (**1980Ew02**) and $\%I(\varepsilon+\beta^+)(\text{g.s.})=19$ 4 (**1980Ew02**), corresponding to $\log ft=5.07$ 5, which was deduced from the $^{35}\text{S}(\text{g.s.}) \rightarrow ^{35}\text{Cl}(\text{g.s.})$ mirror $\log ft=5.01$ 2 with a small asymmetry correction.

$\varepsilon+\beta^+$ feeding is obtained from γ intensity balance at each state, except for proton-emitting states. **1980Ew02** states that in complex decay schemes of heavy nuclides this method is known to be suspect since there is significant γ intensity that is unobserved because it lies in a multitude of very weak γ -ray peaks. In a nucleus as light as ^{35}K the problem is less acute. They have generated a pandemonium test in the same spirit as in **1977Ha51** and find that less than one percent of the γ intensity from ^{35}K decay should be missed for that reason.

E_γ^\dagger	I_γ^\ddagger	$E_i(\text{level})$	J_i^π	E_f	J_f^π	Comments
886.8 5	0.9 3	2637.99	$3/2^+$	1750.72	$(5/2)^+$	$\%I_\gamma=0.46 +19-17$
1044.4 4	1.3 4	5572.66	$3/2^+$	4528.2	$(1/2^+, 3/2^+, 5/2^+)$	$\%I_\gamma=0.66 +25-23$
1184.0 3	14.3 7	1184.01	$1/2^+$	0	$3/2^+$	$\%I_\gamma=7.2$ 5

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$^{35}\text{K } \varepsilon+\beta^+$ decay (175 ms) **1980Ew02** (continued) $\gamma(^{35}\text{Ar})$ (continued)

E_γ^\dagger	I_γ^{\ddagger}	$E_i(\text{level})$	J_i^π	E_f	J_f^π	Comments
1426.8 4	3.0 5	4065.0?	(1/2 ⁺ , 3/2 ⁺ , 5/2 ⁺)	2637.99	3/2 ⁺	%I γ =1.5 +4-3
1507.4 5	1.9 4	5572.66	3/2 ⁺	4065.0?	(1/2 ⁺ , 3/2 ⁺ , 5/2 ⁺)	%I γ =0.96 +27-25
1750.5 3	28 1	1750.72	(5/2 ⁺)	0	3/2 ⁺	%I γ =14.1 9
1798.9 5	3.5 6	2982.79	5/2 ⁺	1184.01	1/2 ⁺	%I γ =1.8 4
2589.8 1	52 2	5572.66	3/2 ⁺	2982.79	5/2 ⁺	%I γ =26.3 18
2638.0 4	5.5 7	2637.99	3/2 ⁺	0	3/2 ⁺	%I γ =2.8 5
^x 2697.7 6						Unplaced γ ray, accounting for no more than 1.2% $\varepsilon+\beta^+$ -feeding (1980Ew02). No ^{35}Ar γ rays at this energy were observed in other reaction studies.
2934.5 5	3.5 6	5572.66	3/2 ⁺	2637.99	3/2 ⁺	%I γ =1.8 4
2982.68 13	100 4	2982.79	5/2 ⁺	0	3/2 ⁺	%I γ =50.5 27
3542.0 6	2.9 6	4725.9	1/2 ⁺	1184.01	1/2 ⁺	%I γ =1.5 4
3821.7 7	3.5 7	5572.66	3/2 ⁺	1750.72	(5/2 ⁺)	%I γ =1.8 5
4387.2 9	3.5 8	5572.66	3/2 ⁺	1184.01	1/2 ⁺	%I γ =1.8 5
4527.9 7	2.6 7	4528.2	(1/2 ⁺ , 3/2 ⁺ , 5/2 ⁺)	0	3/2 ⁺	%I γ =1.3 4
4724.5 11	1.2 5	4725.9	1/2 ⁺	0	3/2 ⁺	%I γ =0.61 +30-27
4785.4 11	1.9 7	4785.8	1/2 ⁺ , 3/2 ⁺ , 5/2 ⁺	0	3/2 ⁺	%I γ =1.0 4
5572.3 10	6.1 16	5572.66	3/2 ⁺	0	3/2 ⁺	%I γ =3.1 +10-9 1980Ew02 observed the double escape peak at 4550 keV of this γ ray. 2018Sa54 observed the photopeak at 5572 keV.

[†] From **1980Ew02**.[‡] For absolute intensity per 100 decays, multiply by 0.505 29.^x γ ray not placed in level scheme.

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Decay Scheme

Legend

Intensities: I_γ per 100 parent decays

- \longrightarrow $I_\gamma < 2\% \times I_\gamma^{\max}$
 \longrightarrow $I_\gamma < 10\% \times I_\gamma^{\max}$
 \longrightarrow $I_\gamma > 10\% \times I_\gamma^{\max}$

\swarrow $\frac{3/2^+}{0}$ 175 ms 2
 $Q_\varepsilon = 11874.4$ 9
 $^{35}_{19}\text{K}_{16}$

