

^{35}Al β^- decay (38.1 ms) 2005Ti11,2001Nu01

Parent: ^{35}Al : $E=0$; $J^\pi=(5/2)^+$; $T_{1/2}=38.1$ ms 4; $Q(\beta^-)=14170$ 40; $\% \beta^-$ decay=100.0

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

^{35}Al - $Q(\beta^-)$: From 2021Wa16.

2005Ti11,2006AnZW: A ^{35}Al secondary beam at ≈ 2 pps was produced via the fragmentation of a 78-MeV/nucleon ^{36}S primary beam and selected by the LISE3 spectrometer at GANIL. A total of 3.46×10^5 ^{35}Al ions were continuously implanted into an NE102A plastic scintillator also for detecting β . The implantation detector was sandwiched between two silicon detectors for monitoring beam and for veto, respectively. Neutrons were detected using the TONNERRE array consisting of 19 plastic scintillator modules. γ rays were detected using two EXOGAM clover modules and a LEPS detector. Measured E_γ , I_γ , E_n , I_n , $\beta\gamma$ -coin, βn -coin, and $\beta n\gamma$ -coin. Deduced the decay scheme consisting of ^{35}Si and ^{34}Si levels, ^{35}Al $T_{1/2}$, decay branching ratios, $\log ft$, $B(\text{GT})$, and β -delayed neutron emission probability. Comparisons with shell-model calculations.

2001Nu01,2002Nu02: Exp 1: A ^{35}Al secondary beam at 8 pps was produced via the fragmentation of a UC target with 1.4 GeV protons at ISOLDE, CERN with subsequent surface-ionization and mass separation. ^{35}Al ions were collected onto a moving tape. β particles were detected using a thin cylindrical plastic scintillator, γ rays were detected using two Ge detectors, and neutrons were detected using eight low-threshold plastic scintillators. Measured E_γ , I_γ , E_n , I_n , $\beta\gamma$ -coin, $\gamma\gamma$ -coin, βn -coin. Deduced the decay scheme consisting of ^{35}Si and ^{34}Si levels, ^{35}Al $T_{1/2}$, decay branching ratios, $\log ft$, and β -delayed neutron emission probability. Comparisons with shell-model calculations. Exp 2: A lifetime measurement for the 974-keV level in ^{35}Si used a thin plastic scintillator for detecting β and a BaF_2 detector for detecting γ .

Other experimental studies on ^{35}Al $T_{1/2}$ and β -delayed neutron emission probability: 2017Ha23, 1999YoZW,

1995ReZZ/2008ReZZ, 1989MuZU, 1989Le16, 1988MuZY, 1988Mu08, 1988DuZT, 1988BaYZ, 1987DuZU, 1987BaZI.

Theoretical studies involving ^{35}Al decay: 2018Yo06, 2013Li39.

 ^{35}Si Levels

$E(n)$ under comments are deduced from $E(n)_{\text{c.m.}} = E(\text{level})(^{35}\text{Si}) - S(n)(^{35}\text{Si}) - E(\text{level})(^{34}\text{Si})$, with $E(\text{level})(^{35}\text{Si})$ reported in 2005Ti11 based on the neutron time-of-flight spectrum. $E(\text{level})(^{34}\text{Si})=3326$ in 2005Ti11. $S(n)(^{35}\text{Si})=2474$ 43 in 2005Ti11, comparable to 2470 40 from 2021Wa16.

$E(\text{level})^\dagger$	J^π^\ddagger	$T_{1/2}^\ddagger$	Comments
0	$(7/2)^-$		
909.95 23	$(3/2)^-$	55 ps 14	
973.88 18	$(3/2)^+$	5.9 ns 6	$T_{1/2}$: lifetime=8.5 ns 9 from the $\beta\gamma(t)$ in 2001Nu01, also adopted in the Adopted Levels.
2168.16 36	$5/2^+$		
3140			Deduced $E(n0)_{\text{c.m.}}=666$.
3450			Deduced $E(n0)_{\text{c.m.}}=976$.
3770			Deduced $E(n0)_{\text{c.m.}}=1296$.
5190			Deduced $E(n0)_{\text{c.m.}}=2716$.
5760			Deduced $E(n0)_{\text{c.m.}}=3286$.
6330			Deduced $E(n0)_{\text{c.m.}}=3856$; $E(n1)_{\text{c.m.}}=530$.
7360			Deduced $E(n1)_{\text{c.m.}}=1560$.
7690			Deduced $E(n1)_{\text{c.m.}}=1890$.

† From a least-squares fit to γ -ray energies for levels connected with γ transitions. For unbound levels, from 2005Ti11 based on the neutron time-of-flight spectrum.

‡ From the Adopted Levels of ^{35}Si .

 β^- radiations

$E(\text{decay})$	$E(\text{level})$	$I\beta^-^\ddagger$	$\log ft$
(6.48×10^3) 4)	7690	2.7 2	4.5
(6.81×10^3) 4)	7360	2.6 2	4.6
(7.84×10^3) 4)	6330	6.8 3	4.5

Continued on next page (footnotes at end of table)

$^{35}\text{Al} \beta^-$ decay (38.1 ms) [2005Ti11](#), [2001Nu01](#) (continued) β^- radiations (continued)

E(decay)	E(level)	$I\beta^-$ ^{†‡}	Log ft	Comments
(8.41×10^3 4)	5760	4.5 2	4.8	
(8.98×10^3 4)	5190	8.9 3	4.6	
(1.040×10^4 4)	3770	3.2 2	5.4	
(1.072×10^4 4)	3450	6.0 3	5.2	
(1.103×10^4 4)	3140	3.3 2	5.5	
(1.200×10^4 4)	2168.16	9.5	5.2	$I\beta^-$: 9.2 19 from 2001Nu01 ; 6.7 9 from 2005Ti11 with only one branch 2168 γ observed.
(1.320×10^4 4)	973.88	52	4.7	$I\beta^-$: 48 9 from 2001Nu01 ; 50 3 from 2005Ti11 .
(1.326×10^4 4)	909.95			$I\beta^-$: <0.9 from 2001Nu01 . The net feeding is deduced to be -1.9 9 from γ +ce intensity balance.
(1.417×10^4 4)	0	3.0 10	6.1 2	$I\beta^-$: 2001Nu01 stated that the β branch to the ^{35}Si ground state was evaluated by comparing the total γ intensity due to the deexcitation of excited states of ^{35}Si with the decay of ^{35}Si activity and assuming no direct ^{35}Si production.

[†] For bound excited states, $I\beta^-$ is from γ +ce intensity balance at each state. Quoted $I\beta^-$ values without uncertainties are considered upper limits due to the incomplete decay scheme, and the associated log ft values are considered lower limits. For unbound excited states, $I\beta^-$ is from the absolute $I\beta^-$ in [2005Ti11](#) based on neutron intensities.

[‡] Absolute intensity per 100 decays.

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

$I\gamma$ normalization: 0.47 4 from $\Sigma\%I(\gamma$ +ce to g.s.)=60 4, deduced from $100 - \% \beta^- n - \% I\beta^-$ (g.s.), where $\% \beta^- n$ =37 4 from the Adopted Levels of ^{35}Al and $\% I\beta^-$ (g.s.)=3.0 10 from [2001Nu01](#). The deduced normalization factor should be considered an upper limit due to potential missing γ transitions from unobserved levels in the gap to the ground state. Other: 0.45 from [2001Nu01](#), based on $\% \beta^- n$ =41 13.

E_γ [†]	I_γ ^{†#}	E_i (level)	J_i^π	E_f	J_f^π	Mult. [‡]	α [@]	Comments
64.1 3	100	973.88	(3/2 ⁺)	909.95	(3/2) ⁻	[E1]	0.0368 8	$\%I\gamma$ =47
910.11 30	99.7 19	909.95	(3/2) ⁻	0	(7/2) ⁻	[E2]	4.13×10^{-5} 6	$\%I\gamma$ =47
973.78 20	11.8 24	973.88	(3/2 ⁺)	0	(7/2) ⁻	[M2]	5.05×10^{-5} 7	$\%I\gamma$ =5.6
^x 1130.4 4	3.2 9							$\%I\gamma$ =1.5
1194.2 4	5.3 12	2168.16	5/2 ⁺	973.88	(3/2 ⁺)			$\%I\gamma$ =2.5
2168.2 6	15 3	2168.16	5/2 ⁺	0	(7/2) ⁻			$\%I\gamma$ =7.1
^x 5629 3	2.4 12							$\%I\gamma$ =1.1

[†] From [2001Nu01](#).

[‡] Deduced from J^π .

For absolute intensity per 100 decays, multiply by 0.47.

@ Total theoretical internal conversion coefficients, calculated using the BrIcc code ([2008Ki07](#)) with "Frozen Orbitals" approximation based on γ -ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

^x γ ray not placed in level scheme.

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Decay Scheme

Intensities: Relative I_γ

Legend

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

