Adopted Levels, Gammas

History			
Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	ENSDF	25-Mar-2022

Q(β^-)=1391×10[1] *28*; S(n)=275×10[1] *27*; S(p)=1415×10[1] *31*; Q(α)=−1080×10[1] *26* 2021Wa16
Q(β^-n)=8250 *260*, S(2n)=7220 *260*, S(2p)=34940 *480* (syst) (2021Wa16).
Q(β^-2n)=4080 *260* deduced by evaluator from relevant mass excesses in 2021Wa16.
1997Be70: ^{56}Sc identified in ^{9}Be(^{238}U,F), E=750 MeV/nucleon, fragments separator (FRS) at GSI facility, identification by time-of-flight. Measured production cross section of 50 nb from 68 counts assigned to ^{56}Sc.
2004Li12: ^{56}Sc produced in ^{9}Be(^{86}Kr,X) fragmentation reaction. Measured Eγ, Iγ, $\gamma\gamma$, $\beta\gamma$, $\beta\gamma$(t) using a double-sided strip detector. Identity of particle from energy loss and time of flight from a PIN detector, the NSCL β calorimeter, and scintillator.
2004Li75 (also 2004Li12,2004Li72,2005Ma93): ^{56}Sc isotope produced in ^{9}Be(^{86}Kr^{34+},X) fragmentation reaction at E=140 MeV/nucleon; A1900 fragment separator. Measured Eγ, Iγ, $\gamma\gamma$, $\beta\gamma$, $\beta\gamma$(t), lifetime using a double-sided Si microstrip detector (DSSD) and the MSU segmented Germanium Array (SeGA). Identity of particle from energy loss and time of flight from a PIN detector, the NSCL β calorimeter, and scintillator. The SeGA array was arranged around the β counting system and comprised twelve Ge detectors. In the mixed (26 ms+75 ms) activity, 2004Li75 estimated 83% *11* contribution from low-spin isomer and 20% *4* from the high-spin isomer, based on absolute γ-ray intensities and deduced β feeding to the ^{56}Ti g.s. Comparison theoretical calculations using shell model and *pf* model space.
2008Ma01 (also 2005Ma93): ^{56}Sc isotope produced in ^{9}Be(^{76}Ge,X) reaction at E=140 MeV/nucleon ^{76}Ge beam provided by NSCL at Michigan State University. Isotopes separated with A1900 fragment separator. Time-of-flight technique.
2010Cr02: E=130 MeV/nucleon ^{76}Ge^{30+} beam provided by the K500 and K1200 cyclotrons at NSCL at Michigan State University. Isotopes separated with A1900 fragment separator. Time-of-flight technique. Fully stripped secondary fragments were sent to NSCL Beta Counting System (BCS). System of three Si PIN detectors, a double-sided silicon strip detector and six single sided silicon strip detectors. Detected γ rays using 16 Ge detectors of the Segmented Germanium array. Measured half-life of ^{56}Sc by fitting the decay curves to a single exponential function with a constant background. Also measured delayed- neutron decay probability.
Mass measurements: 2020Mi13, 2020Me06, 2015Me08.
Theoretical calculations: three reference extracted from the NSR database (www.nndc.bnl.gov/nsr/), listed here under document records.
Additional information 1.
No level-scheme information is available from β^- decay of ^{56}Ca.
ALl data are from ^{56}Sc IT decay dataset.

^{56}Sc Levels

Cross Reference (XREF) Flags

A ^{56}Sc IT decay (0.29 μs)

E(level)	J$^\pi$	T$_{1/2}$	XREF	Comments
0.0	(1$^+$)	26 ms *6*	A	%β^-=100; %β^-n=?; %β^-2n=? Theoretical T$_{1/2}$=16.2 ms, %β^-n=10, %β^-2n=0 (2019Mo01). Theoretical T$_{1/2}$=51.1 ms, %β^-n=2.6, 2.9; %β^-2n=0.17, 0.12 (2021Mi17). E(level),J$^\pi$: shell-model calculations (2004Li75) predict 1$^+$ as ground state from π1f$_{7/2}\otimes\nu$1f$_{5/2}$ configuration. (1$^+$) is also supported by apparent large (probably allowed) β feedings to g.s. and first 2$^+$ states in ^{56}Ti (2010Cr02). T$_{1/2}$: from timing of b-correlated 751γ and 1712γ (2010Cr02). Other: 35 ms *5* (2004Li75, from β decay curve also, 38 ms *5* in 2004Li12, also 2005Ma93). 2010Cr02 and 2004Li75 are from the same laboratory with some of the same authors.
0+x	(5$^+$,6$^+$)	75 ms *6*		%β^-=100; %β^-n>14 *2* (2010Cr02); %β^-2n=? Observation of 591.7 *3* (Iγ=14% *2*) and 1203.5 *3* (Iγ=8% *1*) γ rays from the decay of longer-live activity of ^{56}Sc to ^{55}Ti confirms β-delayed-neutron decay of 75-ms activity of ^{56}Sc (2010Cr02). Authors give %β^-n≥14 *2*, probably considering other

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{56}Sc Levels (continued)

E(level)	J^π	$T_{1/2}$	XREF	Comments
				possible delayed β-delayed-neutron branches. This value is in approximate agreement with theoretical %β^-n=10 from 2019Mo01 for the ground state decay. E(level),J^π: shell-model calculations (2004Li75) predict 6^+ at 543 keV from $\pi 1f_{7/2}\otimes\nu 1f_{5/2}$ configuration. 2004Li75 (also 2005Ma93) proposed (6^+,7^+). However, 2010Cr02 (from the same group as 2004Li75) proposed (5^+,6^+) from apparent large (probably allowed) β feeding of 6^+ state in ^{56}Ti, and apparent β feeding of 4^+ state in ^{56}Ti, although, for the latter, there is possibility of missing γ transitions from higher levels feeding the 4^+ state in ^{56}Ti. $T_{1/2}$: from timing of b-correlated 691γ and 1161γ (2010Cr02). Other: 60 ms *7* (2004Li75, from β-correlated γ decay curve). 2010Cr02 and 2004Li75 are from the same laboratory with some of the same authors.
587.2 *3*	(2^+)†		A	
727.5 *3*	(3^+)†		A	
775.1 *4*	(4^+)†	0.29 μs *2*	A	%IT=100 $T_{1/2}$: weighted average of 0.29 μs *2* (2020Mi13) and 0.290 μs *30* (2010Cr02, fitting the implant correlated isomeric transition decay curve to a single exponential function with a constant background). Others: 0.35 μs *+26−12* (2012Ka36, implants-γ correlated decay); <20 μs (2004Li75, time window selected by 2004Li75 for the observation of isomeric transitions in correlation with implanted nuclei).

† Tentative assignments based on (1^+) for g.s. and E2 assignment to 187.8γ (2010Cr02).

$\gamma(^{56}Sc)$

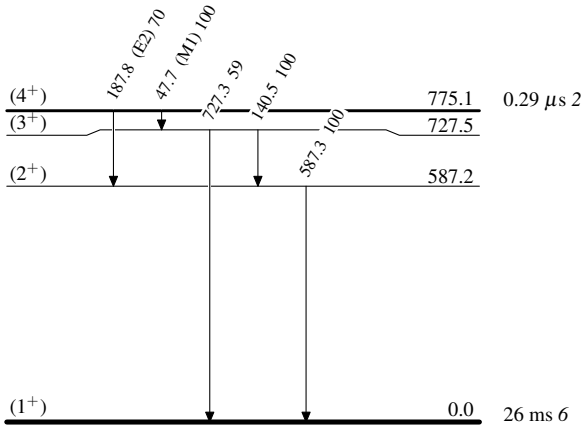
E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.	α†	Comments
587.2	(2^+)	587.3 *3*	100	0.0	(1^+)			
727.5	(3^+)	140.5 *3*	100 *25*	587.2	(2^+)			
		727.3 *4*	59 *10*	0.0	(1^+)			
775.1	(4^+)	47.7 *3*	100 *27*	727.5	(3^+)	(M1)	0.115	B(M1)(W.u.)=0.00038 *7*
		187.8 *3*	70 *19*	587.2	(2^+)	(E2)	0.0263	B(E2)(W.u.)=0.26 *6* Mult.: from Weisskopf estimates (2010Cr02).

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

Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level



$^{56}_{21}Sc_{35}$