^{56}Sc IT decay (0.29 μs) 2010Cr02,2012Ka36,2020Mi13

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

Parent: ^{56}Sc: E=775.1 *4*; $J^{\pi}=(4^+)$; $T_{1/2}$=0.29 μs *2*; %IT decay=100.0

2004Li75: ^{9}Be(^{86}Kr^{34+},X) E=140 MeV/nucleon. Measured Eγ, Iγ 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 six Ge detectors, A1900 fragment separator.

2010Cr02: E=130 MeV/nucleon; measured Eγ, Iγ, $\gamma\gamma$, and half-lives using 16 detectors from the Segmented Germanium Array (SeGA) and BCS detectors at the National Superconducting Cyclotron Laboratory (NSCL). 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 ^{56m}Sc by fitting the (implant correlated) isomeric transition decay curve to a single exponential function with a constant background.

2010Cr02 and 2004Li75 are from NSCL-MSU, with some of the same authors.

2012Ka36: ^{238}U beam at E=345 MeV/nucleon provided by the RIBF accelerator complex at RIKEN facility. Fission fragments were separated and analyzed by BigRIPS separator, transported to focal plane of ZeroDegree spectrometer and finally implanted in an aluminum stopper. Particle identification was achieved by ΔE-tof-Bρ method. Delayed gamma rays from microsecond isomers were detected by three clover-type HPGe detectors. Measured Eγ, Iγ, $\gamma\gamma$-coin, isomer half-life. Comparison with previous studies.

2020Mi13: E=345 MeV/nucleon ^{70}Zn beam produced from the Beam Factory (RIBF) at RIKEN. Target was 2.2 g/cm^2 ^{9}Be. Fragments were separated and identified by the time-of-flight magnetic-rigidity (TOF-Bρ-ΔE) method and energy-loss using the BigRIPS separator, the SHARAQ spectrometer, CVD diamond and silicon strip detectors. Measured mass-to-charge ratios, Eγ, Iγ using a plastic stopper, two HPGe clover detectors and a plastic veto detector. Comparisons with theoretical calculations.

^{56}Sc Levels

E(level)[†]	J^{π}[‡]	$T_{1/2}$	Comments
0.0	(1^+)		
587.2 *3*	(2^+)		
727.5 *3*	(3^+)		
775.1 *4*	(4^+)	0.29 μs *2*	%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).

† From least-squares fit to the Eγ data.

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

$\gamma(^{56}Sc)$

Iγ normalization: From I(γ+ce)(727γ+587γ)=100.

Assignment of observed transitions to feed the 26-ms g.s. was determined in 2010Cr02 from a half-life curve of β-decay events correlated with the ^{56}Sc implants as well as with one of the five prompt γ rays from the decay of the 290-ns isomer. Deduced half-life was 30 ms *5* in agreement with the half-life of lower-spin ^{56}Sc state.

Continued on next page (footnotes at end of table)

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γ(^{56}Sc) (continued)

E_γ	I_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	α[‡]	Comments
47.7 *3*	70 *19*	775.1	(4$^+$)	727.5	(3$^+$)	(M1)	0.115	E_γ,I_γ: from 2010Cr02 only. Mult.: assigned by evaluator based on transition intensity balance at 727.3 level. Note that α(theory)(E2)=5.59 for 47.7-keV transition, does not permit a significant E2 admixture.
140.5 *3*	49 *12*	727.5	(3$^+$)	587.2	(2$^+$)	[M1+E2]	0.044 *37*	E_γ: weighted average of values from 2010Cr02 and 2020Mi13. I_γ: unweighted average of values from 2010Cr02 and 2020Mi13. Eγ=140.5 *3*, Iγ=61 *7* (2010Cr02). Eγ=140.6 *4*, Iγ=37 *8* (2020Mi13). Eγ=140.6 *5* (2012Ka36). Eγ=140 *2*, Iγ=1.4% *1* (2004Li75), relative Iγ=64 *5*.
187.8 *3*	49 *13*	775.1	(4$^+$)	587.2	(2$^+$)	(E2)	0.0263	E_γ: weighted average of values from 2010Cr02 and 2020Mi13. I_γ: unweighted average of values from 2010Cr02 and 2020Mi13. Eγ=187.8 *3*, Iγ=61 *8* (2010Cr02). Eγ=187.9 *5*, Iγ=36 *7* (2020Mi13). Eγ=188.2 *5* (2012Ka36). Eγ=188 *2*, Iγ=1.8% *3* (2004Li75), relative Iγ=82 *14*. Mult.: from Weisskopf estimates (2010Cr02).
587.3 *3*	100 *12*	587.2	(2$^+$)	0.0	(1$^+$)	[E2]	0.00046	E_γ: weighted average of values from 2010Cr02 and 2020Mi13. Eγ=587.2 *3*, Iγ=100 *12* (2010Cr02). Eγ=587.5 *4*, Iγ=100 *18* (2020Mi13). Eγ=587 *2*, Iγ=2.2% *6* (2004Li75); relative Iγ=100 *27*.
727.3 *4*	29 *5*	727.5	(3$^+$)	0.0	(1$^+$)	[E2]	0.00025	E_γ,I_γ: weighted average of values from 2010Cr02 and 2020Mi13. Eγ=727.1 *3*, Iγ=32 *5* (2010Cr02). Eγ=728.0 *6*, Iγ=24 *7* (2020Mi13).

[†] For absolute intensity per 100 decays, multiply by 0.775 *78*.

[‡] 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.

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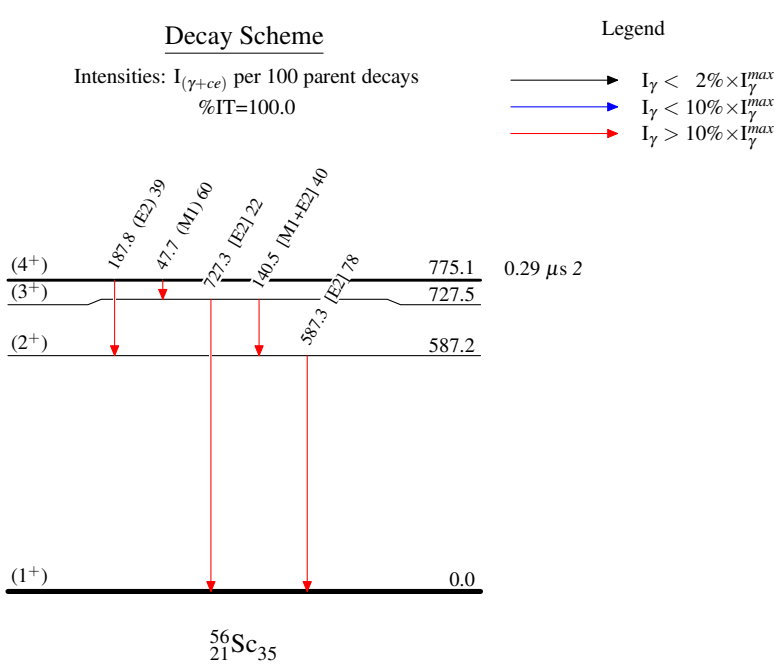
Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays

%IT=100.0



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