Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 188,1 (2023)	17-Jan-2023

$Q(\beta^-)$=1104×10^1 *47*; S(n)=592×10^1 *47*; S(p)=14770 *syst*; $Q(\alpha)$=−13210 *syst*   2021Wa16

Estimated uncertainties (2021Wa16): 550 for S(p), 510 for $Q(\alpha)$.

S(2n)=10130 *470*, S(2p)=33590 *610* (syst), $Q(\beta^-$n)=6770 *470* (2021Wa16).

1992We04: ^{71}Co produced and identified by fragmentation of 500 MeV/nucleon ^{86}Kr beam incident on a beryllium target followed by mass separation in a magnetic spectrometer using in addition time-of-flight and energy loss measurements for nuclide identification. Measured production cross section.

1998Am04 (also 1997AmZZ thesis): ^{71}Co produced in the fragmentation of ^{86}Kr beam at 500 MeV/nucleon with ^{9}Be target at GSI facility. Fragment recoil separator used to separate fragments. Magnetic rigidity and time-of-flight method used to identify the isotope. Measured half-life.

2005GaZR thesis (also 2003So21): ^{71}Co produced in the fragmentation of ^{76}Ge beam at 61.8 MeV/nucleon with ^{58}Ni target at GANIL facility. Lise3 spectrometer was used to separate fragments. Magnetic rigidity and time-of-flight method used to identify the isotope. Measured β, half-life.

2011Da08 (also 2004Sa59, 2002MaZN thesis): ^{71}Co produced in the fragmentation of 57.8 MeV/nucleon ^{86}Kr beam impinged on 50 mg/cm^2 thick tantalum target, followed by separation of fragments using LISE-2000 spectrometer at GANIL facility. Detector system included a three-element Si-detector telescope containing a double-sided silicon-strip detector (DSSSD) backed by a Si(Li) detector and surrounded by four clover type EXOGAM Ge detectors. Products identified by mass, atomic number, charge, energy loss and time of flight. Measured γ rays, $\beta\gamma$-coin, half-life of ^{71}Co decay.

2012Ra10 (also 2005Ma95): ^{71}Co produced in fragmentation of ^{86}Kr beam at 140 MeV/nucleon with a ^{9}Be target at NSCL-MSU facility, followed by separation of fragments using A1900 fragment separator. Particle identification was carried out by energy loss (E-ΔE) and time-of-flight techniques. The ions were implanted in double-sided silicon strip (DSSD) detectors for fragment and β detection. SeGA gamma-detector array containing 16 HPGe detectors was used for $\beta\gamma$-coin, ion-β correlations and isotopic half-life measurements.

Additional information 1.

2019Ly02: ^{71}Co from primary beam of ^{86}Kr at 140 MeV/nucleon impinged on a ^{9}Be target at the NSCL-MSU facility. ^{71}Co separated using A1900 separator, and identified using energy loss and time-of-flight information from a plastic scintillator detector and two silicon PIN detectors, followed by implantation of ^{71}Co nuclei in a 1 mm thick double-sided silicon strip detector (DSSD) which was placed in the geometric center of the Summing NaI(Tl) (SuN) detector. Measured half-life of ^{71}Co decay, and total absorption γ spectrum (TAGS) from ^{71}Co decay.

2020MoZS: one of the evaluators (B. Singh) enquired from the first author (A. Morales) about the possibility of extracting %β^-n for the decay of ^{72}Co investigated by 2016Mo07. Dr. A. Morales in her e-mail communication of May 26, 2020 sent us extracted decay branches for %β^-n and %β^-2n for ^{70,71,72,73,74}Co from analysis of intensities of γ rays emitted in the decay chains of several isotopes, including granddaughters and great-granddaughters. However, some concern was expressed by A. Morales about the quality of the deduced %β^-n and %β^-2n branching ratios, thus the value of %β^-n is listed by the evaluators here as approximate.

Theoretical calculations:

2020Ca08: calculated levels, J^π using shell-model for the spherical and 1/2$^-$ intruder bands.

^{71}Co Levels

Cross Reference (XREF) Flags

A ^{1}H(^{72}Ni,2pγ)

E(level)†	$J^{\pi\ddagger}$	$T_{1/2}$	XREF	Comments
0	(7/2$^-$)	80 ms *3*	A	%β^-=100; %β^-n≈16 *2* (2020MoZS) %β^-n ≈ 16 *2* (2020MoZS). This communication also states %β^-2n=1.4 *3*, but $Q(\beta^-$2n) is −533 *470*, which forbids this decay mode. Other: <2.7 *9* from estimate of intensity of 1259γ in ^{70}Ni (2012Ra10). The observation of 1259γ ray in ^{71}Co decay confirms

Adopted Levels, Gammas (continued)

^{71}Co Levels (continued)

E(level)[†]	J$^{\pi}$[‡]	XREF	Comments
			%β^-=100; %β^-n≈16 *2* (2020MoZS)
			%β^-n ≈ 16 *2* (2020MoZS). This communication also states %β^-2n=1.4 *3*, but Q(β^-2n) is −533 *470*, which forbids this decay mode. Other: <2.7 *9* from estimate of intensity of 1259γ in ^{70}Ni (2012Ra10). The observation of 1259γ ray in ^{71}Co decay confirms existence of the delayed-neutron decay mode. Note that 2005Ma95 stated %β^-n≥3 *1*, which probably should have read ≤3 *1*.
			Theoretical T$_{1/2}$=33.3 ms, %β^-n=4 (2019Mo01).
			Theoretical T$_{1/2}$=179 ms, %β^-n=7.0, 8.5 (2021Mi17).
			J$^{\pi}$: possible πf$_{7/2}^{-1}$ configuration based on systematics (2009St07, 2012Ra10).
			T$_{1/2}$: weighted average of 86 ms *10* (2019Ly02, (implants)γ-correlated decay curve); 80 ms *3* (2012Ra10, time distribution of β-gated γ events); and 79 ms *5* (2011Da08,2004Sa59,2002MaZN, time distribution of (implants)β correlated events, where fitting procedure included five parameters: β-detection efficiency, background rate, mother, daughter and granddaughter half-lives). Others: 97 ms *2* (2003So21,2005GaZR); 210 ms *40* (1998Am04,1997AmZZ). As discussed by 2004Sa59, the half-lives measured by 1998Am04 are systematically higher by a factor of two or three. The difference in measured half-lives (79 ms and 97 ms) in the two GANIL measurements may suggest existence of two activities populated in two different reactions. Even-A Co isotopes generally show isomerism, but no isomerism has yet been found in odd-A Co isotopes. In the absence of confirming evidence for the existence of an isomer in ^{71}Co, evaluators adopt only one half-life. In an e-mail reply of March 7, 2007, author (L. Gaudefroy) of 2005GaZR mentioned that it was less likely that a mistake was made in their work since there was an overall consistency in the measured half-lives of other isotopes.
892 *20*	(9/2$^-$)	A	
1817 *34*	(7/2$^-$)	A	

† From Eγ data.

‡ Proposed by 2020Lo06 from shell-model prediction.

γ(^{71}Co)

E$_i$(level)	J$_i^{\pi}$	E$_{\gamma}$[†]	I$_{\gamma}$[†]	E$_f$	J$_f^{\pi}$
892	(9/2$^-$)	892 *20*	100	0	(7/2$^-$)
1817	(7/2$^-$)	925 *27*	100	892	(9/2$^-$)

† From 2020Lo06.

Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level