

⁶⁹Co β⁻ decay 2019Ly02

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	C. D. Nesaraja	NDS 207,1 (2026)	1-Apr-2023

Parent: ⁶⁹Co: E=0; J^π=(7/2⁻); T_{1/2}=180 ms 20; Q(β⁻)=9590 90; %β⁻ decay=100

⁶⁹Co-J^π,T_{1/2}: From Adopted Levels in ⁶⁹Co.

⁶⁹Co-Q(β⁻): From 2021Wa16.

2019Ly02: ⁶⁹Co was produced at the National Superconducting Cyclotron Lab (MSU) by bombarding ⁸⁶Kr beam at 140 MeV/nucleon on a ⁹Be target. Reaction products were separated by the A1900 fragment separator and identified with a plastic scintillator detector and 2 silicon PIN detectors. The selected isotopes were then implanted in a 1 mm thickness DSSD located at the center of the SuN detector (16 in. by 16 in. NaI(Tl) scintillating detector). Signals from all segments of SuN were summed together into a total absorption spectrum. Measured total absorption spectrum. Deduced beta-decay branching ratios, parent half-life. The β feeding intensities were compared to shell model and QRPA calculations.

⁶⁹Ni Levels

E(level) [†]	J ^π #	T _{1/2}	Comments
0.0	(9/2 ⁺)	11.4 s 3	From email communication between the evaluator and the first author, S.Lyons of 2019Ly02 on 13 November 2024: calculations were performed for only allowed transistions. Iβ feeding to g.s. was not included due to excellent fitting agreements to determine Iβ. Configuration=ν(g _{9/2} ⁺).
321 2	(1/2 ⁻)	3.5 s 4	T _{1/2} : From Adopted Levels. %β ⁻ ≈ 100 T _{1/2} : From the Adopted Level. Note: 1999Mu17 measured T _{1/2} =3.5 s 5 from the beta delayed gamma (1296-keV).
915.3 13	(5/2 ⁻)	120 ps 34	E(level): From 1998Gr14. Configuration=νp _{1/2} ⁽⁺¹⁾ . T _{1/2} : From Adopted Levels.
1517.4 21	(5/2 ⁻)		Configuration=νf _{5/2} ⁽⁺¹⁾ .
1821.2			
1830			
1910 [‡]			
1990 [‡]			
2100 [‡]			
2200 [‡]			
2300 [‡]			
2400 [‡]			
2500 [‡]			
2600 [‡]			
2700 [‡]			
2800 [‡]			
2900 [‡]			
3000 [‡]			
3150 [‡]			
3300 [‡]			
3450 [‡]			
3600 [‡]			
3750 [‡]			
3900 [‡]			

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^{69}Co β^- decay 2019Ly02 (continued)

^{69}Ni Levels (continued)

<u>E(level)[†]</u>	<u>E(level)[†]</u>	<u>E(level)[†]</u>	<u>E(level)[†]</u>
4050 [‡]	5100 [‡]	6300 [‡]	7500 [‡]
4200 [‡]	5300 [‡]	6500 [‡]	7700 [‡]
4350 [‡]	5500 [‡]	6700 [‡]	7900 [‡]
4500 [‡]	5700 [‡]	6900 [‡]	8100 [‡]
4700 [‡]	5900 [‡]	7100 [‡]	8300 [‡]
4900 [‡]	6100 [‡]	7300 [‡]	8500 [‡]

[†] Except as noted, level energies were provided by first author, S. Lyons, of 2019Ly02 via email communication to XUNDL compiler, J. Chen (NSCL, MSU) on 17 October 2019. 43 levels above 1900 are pseudo-levels constructed using the statistical model code DICEBOX to fit the measured total absorption spectrum and the quoted level energies represents an energy band equivalent to the energy resolution of SuN (2019Ly02).

[‡] Pseudo-levels (2019Ly02). These levels are not given in the Adopted Levels.

[#] From Adopted Levels.

β^- radiations

av E β : [Additional information 1.](#)

av E β : [Additional information 2.](#)

<u>E(decay)</u>	<u>E(level)</u>	<u>Iβ^-^{†#}</u>	<u>Log ft[‡]</u>	<u>Comments</u>
(1.09×10 ³ 9)	8500	≈1.5×10 ⁻⁵	7.3	av E β =401
(1.29×10 ³ 9)	8300	≈5.6×10 ⁻⁶	8.0	av E β =489
(1.49×10 ³ 9)	8100	<0.2	3.7	av E β =578
				Log ft: Should be considered as lower limit.
(1.69×10 ³ 9)	7900	≈5.1×10 ⁻⁷	9.5	av E β =669
(1.89×10 ³ 9)	7700	≈2.5×10 ⁻⁷	10.0	av E β =760
(2.09×10 ³ 9)	7500	≈9.0×10 ⁻⁸	10.7	av E β =853
(2.29×10 ³ 9)	7300	≈5.0×10 ⁻⁸	11.1	av E β =946
(2.49×10 ³ 9)	7100	≈1.6×10 ⁻⁷	10.7	av E β =1041
(2.69×10 ³ 9)	6900	≈1.8×10 ⁻⁸	11.8	av E β =1135
(2.89×10 ³ 9)	6700	≈8.1×10 ⁻⁸	11.3	av E β =1230
(3.09×10 ³ 9)	6500	≈3.3×10 ⁻⁷	10.8	av E β =1325
(3.29×10 ³ 9)	6300	≈5.2×10 ⁻⁸	11.7	av E β =1421
(3.49×10 ³ 9)	6100	≈4.5×10 ⁻⁸	11.9	av E β =1517
(3.69×10 ³ 9)	5900	≈5.6×10 ⁻⁹	12.9	av E β =1613
(3.89×10 ³ 9)	5700	≈9.2×10 ⁻⁷	10.8	av E β =1709
(4.09×10 ³ 9)	5500	≈0.6	5.1	av E β =1806
(4.29×10 ³ 9)	5300	≈1.0×10 ⁻⁶	11.0	av E β =1902
(4.49×10 ³ 9)	5100	≈0.2	5.8	av E β =1999
(4.69×10 ³ 9)	4900	≈6.3×10 ⁻⁷	11.3	av E β =2096
(4.89×10 ³ 9)	4700	≈1.5	5.0	av E β =2192
(5.09×10 ³ 9)	4500	≈5.7×10 ⁻⁵	9.5	av E β =2289
(5.24×10 ³ 9)	4350	≈0.5	5.7	av E β =2362
(5.39×10 ³ 9)	4200	≈3.3	4.9	av E β =2435
(5.54×10 ³ 9)	4050	≈2.8	5.0	av E β =2508
(5.69×10 ³ 9)	3900	≈0.7	5.7	av E β =2580
(5.84×10 ³ 9)	3750	≈0.6	5.8	av E β =2653

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⁶⁹Co β⁻ decay 2019Ly02 (continued)

β⁻ radiations (continued)

E(decay)	E(level)	Iβ ^{-†#}	Log ft [‡]	Comments
(5.99×10 ³ 9)	3600	≈2.4	5.2	av Eβ=2726
(6.14×10 ³ 9)	3450	≈3	5.2	av Eβ=2799
(6.29×10 ³ 9)	3300	≈5.8×10 ⁻⁴	8.9	av Eβ=2872
(6.44×10 ³ 9)	3150	≈0.1	6.8	av Eβ=2945
(6.59×10 ³ 9)	3000	≈1.5	5.6	av Eβ=3018
(6.69×10 ³ 9)	2900	≈0.2	6.5	av Eβ=3066
(6.79×10 ³ 9)	2800	≈1.7	5.6	av Eβ=3115
(6.89×10 ³ 9)	2700	≈1.3	5.8	av Eβ=3164
(6.99×10 ³ 9)	2600	≈0.3	6.5	av Eβ=3212
(7.09×10 ³ 9)	2500	≈2.6	5.5	av Eβ=3261
(7.19×10 ³ 9)	2400	≈0.6	6.2	av Eβ=3310
(7.29×10 ³ 9)	2300	≈1.2	5.9	av Eβ=3358
(7.39×10 ³ 9)	2200	≈2.6	5.6	av Eβ=3407
(7.49×10 ³ 9)	2100	≈2.8	5.6	av Eβ=3456
(7.60×10 ³ 9)	1990	≈0.9	6.1	av Eβ=3509
(7.68×10 ³ 9)	1910	≈6.1×10 ⁻⁶	11.3	av Eβ=3548
(7.76×10 ³ 9)	1830	≈0.0090	8.2	av Eβ=3587
(7.77×10 ³ 9)	1821.2	2.6 24	5.7	av Eβ=3592
Log ft: Uncertainty not provided by BETASHAPE code as there is no uncertainty in the level energy.				
(8.07×10 ³ 9)	1517.4	22.5 19	4.86 6	av Eβ=3738 44
(8.68×10 ³ 9)	915.3	43.2 12	4.73 5	av Eβ=4030 44

† From fit to measured total absorption spectrum, the sum-of-segments spectrum, and the multiplicity spectrum in 2019Ly02. Beta intensities were provided by first author, S. Lyons, of 2019Ly02 via email communication to XUNDL compiler, J. Chen (NSCL, MSU) on 17 October 2019. For pseudo-levels, quoted branching ratios are for an energy band around quoted level energies, with the band equivalent to the energy resolution of SuN (2019Ly02). For those approximate values, their original uncertainties from the author are much greater than the values themselves.

‡ Should be considered as approximate when Iβ is approximate.

Absolute intensity per 100 decays.

γ(⁶⁹Ni)

I_γ normalization: Absolute intensities from 2015Li33 were deduced based on the observed γ-ray intensities, absolute efficiency of SeGA, the number of β-decay electrons attributed to ⁶⁹Co, and the total number of ions produced.

E _γ	I _γ ^{†&}	E _i (level)	J _i ^π	E _f	J _f ^π	Comments
303.6 ^a		1821.2		1517.4	(5/2 ⁻)	E _γ : Reported by 1999Mu17 but was not observed by 2015Li33. The evaluator considers this transition questionable.
594.2 4	42 4	915.3	(5/2 ⁻)	321	(1/2 ⁻)	E _γ : From 2015Li33.
602.4 4	4.4 12	1517.4	(5/2 ⁻)	915.3	(5/2 ⁻)	I _γ : From 2015Li33. Others: 29 3 (Erratum 2015Li33, source from ⁶⁹ Fe decay); 56.7 47 (1999Mu17).
^x 1128.5 ^{‡#} 5	2.6 11					E _γ : From 2015Li33. Others: 2.4 7 (Erratum 2015Li33, source from ⁶⁹ Fe decay); 8.9 12 (1999Mu17).
1196.3 4	9.0 20	1517.4	(5/2 ⁻)	321	(1/2 ⁻)	I _γ : Others: 2.5 7 (Erratum 2015Li33, source from ⁶⁹ Fe decay); 8.3 13 (1999Mu17).
						E _γ : From 2015Li33. Others: 7.4 10 (Erratum 2015Li33, source from ⁶⁹ Fe decay); 11.2 16 (1999Mu17).

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^{69}Co β^- decay 2019Ly02 (continued) $\gamma(^{69}\text{Ni})$ (continued)

E_γ	I_γ ^{†&}	E_i (level)	Comments
^x 1319.6 [#]	1	0.6 3	I_γ : Others: 4.1 9 (Erratum 2015Li33, source from ^{69}Fe decay); 9.2 14 (1999Mu17).
^x 1343 [‡]			
^x 1545 [‡]			
^x 1580.6 [@]			
^x 1642 [‡]			
^x 1824.0 [@]			
^x 2879.8 [@]			

[†] From γ -ray spectrum recorded within 1 s of arrival of directly produced ^{69}Co ion in 2015Li33. Corresponding values obtained from $^{69}\text{Fe} \rightarrow ^{69}\text{Co} \rightarrow ^{69}\text{Ni}$ decay chain (2015Li33) are given in comments. 1999Mu17 intensities which have been converted to absolute intensities by 2015Li33 are also given in the comments. Values from 1999Mu17 and 2015Li33 are in disagreement, based on which the existence of an isomeric state in ^{69}Co and that the source produced by 1999Mu17 contained both the activities (2015Li33).

[‡] The γ ray observed in the spectrum using the source from ^{69}Fe decay, but barely, if at all, in the spectrum obtained from directly produced ^{69}Co (2015Li33).

[#] Larger intensity observed in source from ^{69}Fe decay suggests that this γ ray depopulates a low-spin level in ^{69}Ni (2015Li33).

[@] From 1999Mu17 not observed by 2015Li33.

[&] Absolute intensity per 100 decays.

^a Placement of transition in the level scheme is uncertain.

^x γ ray not placed in level scheme.

^{69}Co β^- decay 2019Ly02

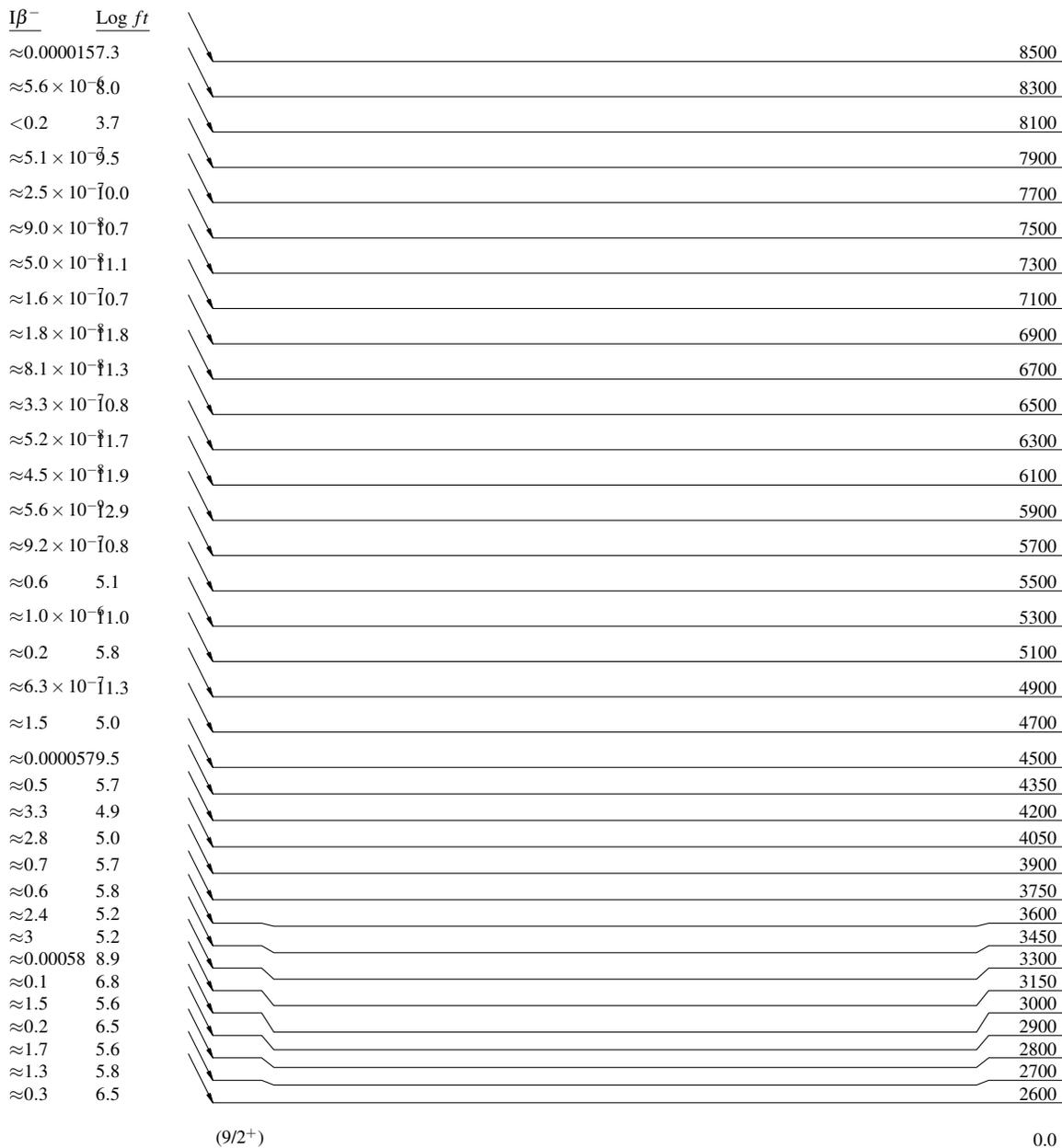
Decay Scheme

Intensities: Relative I_γ

Legend

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

$(7/2^-)$ 0 180 ms 20
 $Q_{\beta^-} = 9590$ 90
 $\% \beta^- = 100$
 $^{69}_{27}\text{Co}_{42}$



11.4 s 3

$^{69}_{28}\text{Ni}_{41}$

$^{69}\text{Co} \beta^-$ decay 2019Ly02

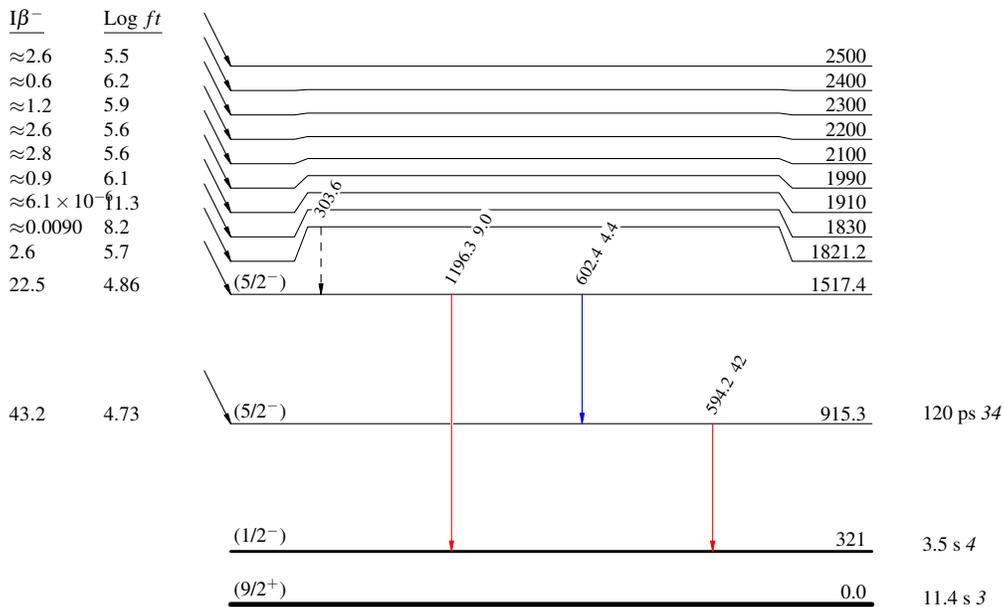
Decay Scheme (continued)

Intensities: Relative I_γ

Legend

- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- - - - - γ Decay (Uncertain)

$(7/2^-)$ 0 180 ms 20
 $Q_{\beta^-} = 9590.90$ % $\beta^- = 100$
 $^{69}\text{Co}_{42}$



$^{69}\text{Ni}_{41}$