^{71}Kr ε decay (94.9 ms) 2022Wa34,1997Oi01

History

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

Parent: ^{71}Kr: E=0; J^π=(5/2)$^-$; $T_{1/2}$=94.9 ms *4*; Q(ε)=1018×10[1] *13*; %ε+%$β^+$ decay=100

^{71}Kr-J^π,$T_{1/2}$: From ^{71}Kr Adopted Levels.

^{71}Kr-Q(ε): From 2021Wa16.

^{71}Kr-%ε+%$β^+$ decay: %εp=3.06 *27* (2022Wa34) for the decay of ^{71}Kr, deduced from measurement of β-delayed proton spectrum correlated with implants. Other %εp: 2.1 *7* (1997Oi01), 5.2 *6* (1995Bl23).

2022Wa34: ^{71}Kr produced in ^{9}Be(^{92}Mo,X),E=140 MeV/nucleon reaction, followed by separation of ions of interest using A1900 fragment separator and a Radio Frequency Fragment Separator (RFFS) at the Coupled Cyclotron Facility of NSCL-MSU. The ions in the cocktail beam were implanted into the β-counting station (BCS), which consisted of a stack of PIN detector (PIN2) and Double-Sided Silicon-Strip Detector (DSSSD) for detection of implants, surrounded by the SeGA array of 16 HPGe detectors for γ detection. Measured Eγ, Iγ, (implants)β-coin, (implants)(β-delayed protons)-coin, (implants)γγ-coin, (implants)βγ-coin, $T_{1/2}$ of decay of ^{71}Kr. Deduced absolute (per 100 decays of parent) number of βγ-coin events, β events, absolute (per 100 decays of parent) intensities of γ rays, and intensities of β-delayed protons.

1997Oi01: ^{93}Nb(p,X) at 1 GeV, CERN-ISOLDE facility. Pure Kr beam was implanted into an aluminized Mylar film. Measured Eγ, Iγ, β, β-delayed protons, γγ, γβ coin, $T_{1/2}$. Detection system: gas-Si detector telescope for protons, HPGe detectors for γ and x rays, telescope plastic scintillation detectors for high-energy β rays, gas-Si detector for low-energy β rays.

2005Fi10: reinterpretation of γ-ray spectrum in 1997Oi01, but details of these results are not available.

1982Ha32: isotopic identification and measurement of half-life.

1981Ew01: ^{93}Nb(p,X),E=1 GeV at CERN, chemical mass separation. plastic scintillator telescope; measured half-life.

Production and identification of ^{71}Kr:

2002Lo13, 2002Bl17, 1995Bl23: C(^{78}Kr,X),E=73 MeV/nucleon.

^{71}Br Levels

2022Wa34 reported little evidence for coincidence of 208γ from a 407-keV γ; which would indicate population of the 615-keV level in ^{71}Br, as tentatively proposed by 2005Fi10, with 208γ and 407γ from this level. In the decay scheme proposed by 2022Wa34, a 615 level with J^π=3/2$^-$,7/2$^-$ was listed, but it was assumed that this level was not populated in the decay of ^{71}Kr.

E(level)†	J^π‡	$T_{1/2}$‡	Comments
0.0	(5/2)$^-$	21.4 s *6*	J^π: 5/2$^-$ in 2022Wa34.
9.86 *14*	(1/2$^-$)		E(level): from the Adopted Levels. J^π: 1/2$^-$ in 2022Wa34.
207.97 *16*	(3/2$^-$)		J^π: 3/2$^-$ in 2022Wa34.
407.12 *24*	(5/2)$^-$		J^π: 5/2$^-$ in 2022Wa34. Level proposed by 2005Fi10 from spectral data of 1997Oi01, and confirmed by 2022Wa34.
1861+x			E(level): S(p)(^{71}Br)+x, where x<8319 keV, from Q(e)(^{71}Kr)-S(p)(^{71}Br). E(level): wide group from E(p)=1.5 to 5.5 MeV, this proton group feeding the g.s. and the first excited state of ^{70}Se (2022Wa34). Other: ≈4250 (1997Oi01) from wide group from E(p)≈2.3 MeV, a broad bump at this energy, assuming that this proton group feeds the g.s. of ^{70}Se.

† From least-squares fit to Eγ data.

‡ From the Adopted Levels.

^{71}Kr ε decay (94.9 ms) 2022Wa34,1997Oi01 (continued)

ε,β+ radiations

E(decay)	E(level)	Iβ+ ‡	Iε‡	Log *ft*	I(ε+β+)†‡	Comments
(4×10^3# *4*)	1861+x				3.06 *27*	I(ε+β+): from measured delayed-proton branch (2022Wa34). Others: 2.1% *7* (1997Oi01), 5.2% *6* (1995Bl23).
(9.77×10^3 *13*)	407.12	4.4 *4*	0.0086 *9*	4.87 *5*	4.4 *4*	av Eβ=4152 *65*; εK=0.00171 *8*; εL=0.000195 *9*; εM+=3.91×10^−5 *18* I(ε+β+): 4.32% *36* (2022Wa34). Other: I(ε+β+)≈15% estimated by 2005Fi10 based on γ-ray intensities deduced by the authors from γ-ray spectrum of 1997Oi01, which is in severe disagreement with the value in 2022Wa34.
(9.97×10^3 *13*)	207.97	1.0 *8*	0.0018 *15*	5.6 *4*	1.0 *8*	av Eβ=4251 *65*; εK=0.00160 *7*; εL=0.000183 *8*; εM+=3.66×10^−5 *17* I(ε+β+): 1.02 *71* in 2022Wa34. Other I(ε+β+): 15.8% *14* (1997Oi01), based on relative efficiency of the γ-ray detectors with respect to the particle telescope; 15% (2005Fi10, from reanalysis of data in 1997Oi01). Both the values are in severe disagreement from that in 2022Wa34.
(1.018×10^4 *13*)	0.0	91.3 *9*	0.156 *7*	3.65 *3*	91.5 *9*	av Eβ=4353 *65*; εK=0.00150 *7*; εL=0.000171 *8*; εM+=3.42×10^−5 *15* I(ε+β+): from 100-summed feeding to excited states. 91.6 *20* in 2022Wa34; 89% from β measurement (2022Wa34), 82.1% *16* (1997Oi01), 68% (2005Fi10, from reanalysis of data in 1997Oi01).

† Deduced by evaluators from I(γ+ce) balances in the decay scheme, with g.s. ε+β+ feeding from 100−(ε+β+ feeding to the excited states). The values are very slightly different from those in 2022Wa34. The analysis of the γ-ray spectra and decay scheme by 2022Wa34 assumed negligible ε+β+ feedings to the levels above the 407 level, which seems justified by directly measured β feeding of 89% in 2022Wa34.

‡ Absolute intensity per 100 decays.

Estimated for a range of levels.

^{71}Kr ε decay (94.9 ms) 2022Wa34,1997Oi01 (continued)

γ(^{71}Br)

Iγ normalization: 2022Wa34 determined absolute γ-ray intensities.
1997Oi01 reported Iγ(relative)<8 for a 262γ from a 262 level, and Iγ(relative)<10 for a 599γ from an 806 level; based on observation of the γ rays and levels in in-beam γ-ray study by 1990Ar23. These two γ were not reported by 2022Wa34 in the decay of ^{71}Kr.

E_γ	I_γ[#@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	δ	α[&]	$I_{(\gamma+ce)}$[@]	Comments
(9.86 *14*)		9.86	(1/2$^-$)	0.0	(5/2)$^-$	[E2]		5.2×10^3 *4*	2.7 *7*	α(L)=4.4×10^3 *4*; α(M)=7.0×10^2 *6*; α(N)=45 *4* E_γ: from the Adopted Levels, Gammas dataset. $I_{(\gamma+ce)}$: deduced by evaluators from intensity balance at 9.8-keV level.
198.0[‡] *2*	2.07 *60*	207.97	(3/2$^-$)	9.86	(1/2$^-$)	(M1+E2)	+0.21 *7*	0.0208 *16*		α(K)=0.033 *19*; α(L)=0.0039 *23*; α(M)=6.E−4 *4*; α(N)=5.5×10^{-5} *31* Others: Eγ=198/199 (2022Wa34) as unresolved doublet; Eγ=198, Iγ(relative)=100 (1997Oi01) or 85 from a reanalysis of γ-ray spectrum in 1997Oi01. 2005Fi10 suggested that 198γ was a doublet, with 15% of this intensity belonging to a 199γ from 407 level, and 85% to 198γ from 208 level. This estimate is not confirmed by 2022Wa34, where Iγ(198.0 from 208 level)/Iγ(199.0 from 407 level)=0.81 *25*. Mult.,δ: from the Adopted Levels, Gammas dataset.
199.0[‡] *5*	2.56 *29*	407.12	(5/2)$^-$	207.97	(3/2$^-$)	[M1+E2]		0.04 *3*		α(K)=0.038 *23*; α(L)=0.005 *3*; α(M)=0.0007 *5*; α(N)=7.0×10^{-5} *4* Other Iγ(relative)≈16 deduced by 2005Fi10 from γ-spectrum in 1997Oi01, and Iγ(199γ)/Iγ(407γ)=15/60 (2005Fi10). This value is in severe disagreement with that from 2022Wa34.
208.0[†] *2*	1.51 *24*	207.97	(3/2$^-$)	0.0	(5/2)$^-$	[M1+E2]		0.038 *21*		α(K)=0.033 *19*; α(L)=0.0039 *23*; α(M)=6.E−4 *4*; α(N)=5.5×10^{-5} *31* Other: Eγ: 208, Iγ(relative)=36 (1997Oi01). From a reanalysis of γ-ray spectrum in 1997Oi01, 2005Fi10 suggested that 208γ was a doublet with 207γ from 208 level, and a 208γ from a 615 level. From Iγ(207γ)/Iγ(198γ)=19/81 (2005Fi10); Iγ(208)(relative)≈20 from 208 level.
397.1[†] *3*	0.55 *8*	407.12	(5/2)$^-$	9.86	(1/2$^-$)	[E2]		0.00617 *9*		α(K)=0.00546 *8*; α(L)=0.000605 *9*; α(M)=9.59×10^{-5} *14*; α(N)=8.78×10^{-6} *13* Other Iγ(relative)≈27 deduced by 2005Fi10 from

$^{71}_{35}Br_{36}$-3

^{71}Kr ε decay (94.9 ms) 2022Wa34,1997Oi01 (continued)

$\gamma(^{71}Br)$ (continued)

E_γ	I_γ[#@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	δ	α[&]	Comments
									γ-spectrum in 1997Oi01, and Iγ(397γ)/Iγ(407γ)=25/60 (2005Fi10). Mult.: Q in the Adopted Levels, Gammas dataset.
407.4[†] *4*	1.21 *20*	407.12	$(5/2)^-$	0.0	$(5/2)^-$	(M1+E2)	−0.74 *14*	0.0044 *13*	α(K)=0.0039 *12*; α(L)=0.00043 *13*; α(M)=6.8×10^{-5} *21*; α(N)=6.2×10^{-6} *19* Other Iγ(relative)≈64 deduced by 2005Fi10 from spectrum in 1997Oi01. Mult.,δ: from the Adopted Levels, Gammas dataset.

[†] From 2022Wa34.
[‡] From 2005Fi10 in ^{40}Ca(^{40}Ca,2αpγ).
[#] Absolute (per 100 decays of ^{71}Kr) intensities from 2022Wa34.
[@] Absolute intensity per 100 decays.
[&] 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.

$^{71}_{35}Br_{36}$-4

^{71}Kr ε decay (94.9 ms) 2022Wa34,1997Oi01

Decay Scheme

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