^{84}Br β^- decay (31.76 min) 1972Hi03,1970Ha21,1980Sa10

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	J. K. Tuli, A. Luca, S. Juutinen, and B. Singh	NDS 110,2815 (2009)	30-Sep-2009

Parent: ^{84}Br: E=0; $J^\pi=2^-$; $T_{1/2}$=31.76 min *8*; Q(β^-)=4629 *15*; %β^- decay=100.0

^{84}Br-$T_{1/2}$: weighted average of the following values in minutes: 31.7 *2* (1960Sa05), 31.80 *8* (1957Jo21), 31.6 *2* (1956Fi36). Other values: 32 (1951Du03), 33 (1950Ka02), 30 (1943Bo02,1943Bo01), 30 (1940St03), ≈40 (1939Do02), ≈30 (1939Ha14).

^{84}Br-Q(β^-): from 2009AuZZ. Other: 4632 *14* (2003Au03).

1972Hi03: Measured Eγ, Iγ, γγ; chemical separation of ^{84}Br activity, γγ coin with Ge(Li) and NaI(Tl) detectors. A total of 51 γ rays reported. Level scheme is extended from that proposed In 1970Ha21. Intensity detection threshold is ≈0.04 relative to 100 for 882γ.

1970Ha21: Measured Eγ, Iγ, γγ, β, βγ coin; Ge(Li), NaI(Tl), magnetic spectrometer, anthracene crystal. Deduced Q value=4650 *30*. A total of 32 γ rays reported placed amongst 15 excited states. Intensity detection threshold is ≈0.1 relative to 100 for 882γ.

1980Sa10: Measured γγ(θ).

1973Jo02: measured total-absorption γ spectra, deduced β strength functions using mass-separated fission products at OSIRIS facility. The β spectrum has two intense peaks, one below 1 MeV and the other at about 2 MeV. Weak feedings continue up to about 4 MeV. These data are further analyzed by 1983Be56.

Other: 1957Jo21.

Additional information 1.

A detailed decay scheme proposed by 1970Ha21 was further augmented by 1972Hi03.

The γγ coin information is from 1972Hi03 and 1970Ha21.

Total decay energy deposit of 4640 keV *190* calculated by RADLIST code is in agreement with expected value of 4629 keV *15*.

^{84}Kr Levels

A 2171, $(0)^+$ level proposed by 1970Ha21 has been omitted here, the deexciting γ ray of 1289 keV has not been seen by 1972Hi03 and the level itself has not been confirmed in any other study.

E(level)†	Jπ‡	$T_{1/2}$	E(level)†	Jπ‡	E(level)†	Jπ‡
0.0	0^+	stable	2623.01 *25*	2^+#	3870.4 *7*	1,2,3
881.61 *9*	2^+		2699.93 *17*	3^-#	3878.7 *4*	$(2^+,3)$
1837.3 *20*	0^+		2759.1 *3*	2^+#	3927.30 *23*	1^-
1897.63 *14*	2^+#		3082.01 *20*	3#	4084.3 *5*	$(1,2^+)$
2094.95 *19*	4^+#		3365.85 *21*	$(1,2^+)$#	4116.8 *5*	$1^-,2^-$
2345.24 *22*	4^+#		3475.57 *24*	(1^-)	4189.2? *6*	$(2^+,3)$
2489.2 *4*	$(2^+,3^-)$		3705.76 *21*	$1^{(-)},2,3^{(-)}$		

† From least-squares fit to Eγ's.
‡ From Adopted Levels.
# From γγ(θ) analysis.

β^- radiations

E(decay)	E(level)	Iβ⁻†	Log *ft*	Comments
(440‡ *15*)	4189.2?	0.21 *5*	5.9 *1*	av Eβ=136.2 *55*
(512 *15*)	4116.8	2.1 *4*	5.1 *1*	av Eβ=162.6 *56*
(545 *15*)	4084.3	0.48 *7*	5.84 *8*	av Eβ=174.7 *57*
(702 *15*)	3927.30	11.5 *13*	4.85 *6*	av Eβ=235.1 *60*
(750 *15*)	3878.7	0.29 *4*	6.56 *7*	av Eβ=254.5 *61*
(759 *15*)	3870.4	0.17 *5*	6.8 *2*	av Eβ=257.8 *61*

Continued on next page (footnotes at end of table)

^{84}Br β^- decay (31.76 min) 1972Hi03,1970Ha21,1980Sa10 (continued)

β^- radiations (continued)

E(decay)	E(level)	Iβ^-[†]	Log *ft*	Comments
(923 *15*)	3705.76	2.5 *3*	5.95 *6*	av Eβ=325.0 *63*
(1153 *15*)	3475.57	0.49 *14*	7.0 *1*	av Eβ=422.5 *65*
(1263 *15*)	3365.85	9.4 *11*	5.89 *6*	av Eβ=470.2 *66*
(1547 *15*)	3082.01	3.9 *5*	6.62 *6*	av Eβ=596.1 *68* $\beta\gamma$ data (1970Ha21): Eβ(endpoint)=1600 *100* (coin with 382γ,737γ), 1550 *100* (coin with 1464γ).
(1870 *15*)	2759.1	1.12 *23*	7.5 *1*	av Eβ=742.7 *69*
(1929 *15*)	2699.93	7.3 *9*	6.74 *6*	av Eβ=769.9 *69* $\beta\gamma$ data (1970Ha21): Eβ(endpoint)=1750 *100* (coin with 355γ), 1800 *100* (coin with 605γ), 1950 *100* (coin with 802γ), 1750 *100* (coin with 1213γ).
(2006 *15*)	2623.01	1.7 *3*	7.4 *1*	av Eβ=805.4 *70* $\beta\gamma$ data (1970Ha21): Eβ(endpoint)=1700 *100* (coin with 1741γ).
(2140 *15*)	2489.2	0.33 *7*	8.3 *1*	av Eβ=867.3 *70*
(2284[‡] *15*)	2345.24	<0.9	>9.1[1u]	av Eβ=943.9 *69*
(2534[‡] *15*)	2094.95	<0.4	>9.8[1u]	av Eβ=1059.2 *70*
(2731 *15*)	1897.63	11.7 *22*	7.2 *1*	av Eβ=1144.8 *71* Iβ^-: 11 from Kurie-plot analysis of singles β spectrum with endpoint energy of 3810 *50* (1970Ha21). $\beta\gamma$ data (1970Ha21): Eβ(endpoint)=2700 *100* (coin with 1016γ), 2750 *100* (coin with 1898γ); 1016γ also in coin with 1850β and 1898 γ with 1800β.
(2792[‡] *15*)	1837.3	0.06 *3*	10.8[1u] *2*	av Eβ=1179.0 *71*
(3747 *15*)	881.61	13.5 *16*	7.70 *6*	av Eβ=1629.0 *72* Iβ^-: 20 from Kurie-plot analysis of singles β spectrum with endpoint energy of 3810 *50* (1970Ha21). E(decay): endpoint energy=3810 50 (1970Ha21) from singles β spectrum. $\beta\gamma$ coin (1970Ha21): Eβ(endpoint)=3750 *100* (coin with 882γ); 882γ also in coin with 2750β, 1900β, 1350β.
(4629 *15*)	0.0	33 *5*	9.46[1u] *7*	av Eβ=2050.5 *72* Shape of β spectrum (Kurie plot) is first-forbidden unique (1970Ha21). E(decay): endpoint energy=4680 50 (1970Ha21) from singles β spectrum.

[†] Absolute intensity per 100 decays.
[‡] Existence of this branch is questionable.

^{84}Br β^- decay (31.76 min) 1972Hi03,1970Ha21,1980Sa10 (continued)

$\gamma(^{84}Kr)$

Iγ normalization: from summed I(γ+ce) of γ′s to g.s.=67 *5*. Iβ(g.s.)=33% 5 is the average of 34% (from Kurie plot analysis of 1970Ha21) and 32% 5 (from absolute Iγ measurement of 1957Jo21).

The 1289γ (Iγ=0.4), 1970γ (Iγ=0.6) and 2304γ (Iγ=0.6) reported by 1970Ha21 were not seen by 1972Hi03 with upper limits of 0.04, 0.15 and 0.1, respectively. The 1289γ was placed in 1970Ha21 from a 2171, $(0)^+$ level; other two γ rays were unplaced.

γγ directional-correlation coefficients are from 1980Sa10. J sequence, δ for the first γ ray is from the evaluators′ analysis. Large-δ solutions for implied E1+M2 and E2+M3 transitions have been discounted.

E_γ‡	I_γ‡&	E_i(level)	J_i^π	E_f	J_f^π	Mult.#	δ#	α†	Comments
230.2 *2*	0.73 *10*	3705.76	$1^{(-)},2,3^{(-)}$	3475.57	(1^-)	[D,E2]		0.026 *18*	Additional information 22.
339.8 *4*	0.17 *4*	3705.76	$1^{(-)},2,3^{(-)}$	3365.85	$(1,2^+)$	[D,E2]		0.007 *4*	Additional information 23.
354.7 *2*	0.73 *10*	2699.93	3^-	2345.24	4^+	[E1]		0.00234 *4*	α=0.00234 *4*; α(K)=0.00208 *3*; α(L)=0.000222 *4*; α(M)=3.58×10^{-5} *5*; α(N+..)=3.59×10^{-6} *5* α(N)=3.59×10^{-6} *5* Additional information 10.
382.0 *2*	1.35 *20*	3082.01	3	2699.93	3^-	[D,E2]		0.005 *3*	Additional information 15.
394.1[a@b] *7*		2489.2	$(2^+,3^-)$	2094.95	4^+				E_γ: from coin with 1213γ.
394.1[ab] *7*		3475.57	(1^-)	3082.01	3				
394.1[ab] *7*		3870.4	1,2,3	3475.57	(1^-)				
447.7 *8*	0.10 *3*	2345.24	4^+	1897.63	2^+	[E2]		0.00450 *7*	α=0.00450 *7*; α(K)=0.00398 *6*; α(L)=0.000443 *7*; α(M)=7.17×10^{-5} *11*; α(N+..)=7.11×10^{-6} *11* α(N)=7.11×10^{-6} *11* Additional information 6.
561.4[@] *5*	0.20 *5*	3927.30	1^-	3365.85	$(1,2^+)$				E_γ: from coin with high-energy γ rays.
604.8 *3*	4.2 *6*	2699.93	3^-	2094.95	4^+	(E1+M2)	+0.025 *23*	0.000620 *11*	α=0.000620 *11*; α(K)=0.000551 *10*; α(L)=5.83×10^{-5} *10*; α(M)=9.42×10^{-6} *17*; α(N+..)=9.50×10^{-7} *1* α(N)=9.50×10^{-7} *17* Additional information 11. (605γ)[1213γ](882γ)(θ): A_2=−0.161 *19*, A_4=+0.02 *3*.
^{x}688.7[@] *7*	0.22 *6*								E_γ,I_γ: from coin with 1213γ.
736.5 *3*	3.1 *5*	3082.01	3	2345.24	4^+	D+Q	−0.09 *3*		Additional information 16. (736γ)[1464γ](882γ)(θ): A_2=−0.067 *24*, A_4=−0.05 *4*.
802.2 *2*	14.4 *15*	2699.93	3^-	1897.63	2^+	(E1+M2)	−0.04 *3*	0.000335 *7*	α=0.000335 *7*; α(K)=0.000298 *7*; α(L)=3.14×10^{-5} *7*; α(M)=5.07×10^{-6} *11*; α(N+..)=5.12×10^{-7} *11* α(N)=5.12×10^{-7} *11* Additional information 12. (803γ)(1898γ)(θ): A_2=−0.106 *27*, A_4=+0.05 *5*.
881.6 *1*	100	881.61	2^+	0.0	0^+	(E2)		0.000670 *10*	α=0.000670 *10*; α(K)=0.000595 *9*; α(L)=6.39×10^{-5} *9*; α(M)=1.033×10^{-5} *15*; α(N+..)=1.039×10^{-6} *1*

$^{84}_{36}Kr_{48}$-3

^{84}Br β^- decay (31.76 min) 1972Hi03,1970Ha21,1980Sa10 (continued)

$\gamma(^{84}Kr)$ (continued)

E_γ[‡]	I_γ[‡&]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	α[†]	Comments
									α(N)=1.039×10^{-6} *15* Additional information 2.
947.5 *7*	0.85 *20*	3705.76	1$^{(-)}$,2,3$^{(-)}$	2759.1	2$^+$				Additional information 24.
955.7[@] *20*	0.15 *7*	1837.3	0$^+$	881.61	2$^+$				
987.3 *4*	1.9 *3*	3082.01	3	2094.95	4$^+$	D+Q	−0.09 *4*		Additional information 17. (987γ)[1213γ](882γ)(θ): A_2=−0.07 *4*, A_4=−0.02 *6*.
1005.7[@] *7*	1.1 *3*	3705.76	1$^{(-)}$,2,3$^{(-)}$	2699.93	3$^-$				
1015.9 *3*	14.8 *15*	1897.63	2$^+$	881.61	2$^+$	(M1+E2)	+0.84 *7*	0.000460 *7*	α=0.000460 *7*; α(K)=0.000409 *6*; α(L)=4.34×10^{-5} *7*; α(M)=7.03×10^{-6} *10*; α(N+..)=7.11×10^{-7} *11* α(N)=7.11×10^{-7} *11* Additional information 3. (1016γ)(882γ)(θ): A_2=−0.235 *14*, A_4=+0.164 *22*.
1082.6[@] *4*	0.34 *6*	3705.76	1$^{(-)}$,2,3$^{(-)}$	2623.01	2$^+$				
1119.1[@] *4*	0.34 *6*	3878.7	(2$^+$,3)	2759.1	2$^+$				
[x]1142.7[@] *10*	0.08 *3*								E_γ,I_γ: from coin with high-energy γ rays between 2200 and 2800 keV.
1185.0[@] *7*	0.26 *5*	3082.01	3	1897.63	2$^+$				E_γ: from coin with 1898γ.
1213.3 *2*	6.2 *7*	2094.95	4$^+$	881.61	2$^+$	(E2)		0.000331 *5*	α=0.000331 *5*; α(K)=0.000285 *4*; α(L)=3.03×10^{-5} *5*; α(M)=4.89×10^{-6} *7*; α(N+..)=1.075×10^{-5} *16* α(N)=4.94×10^{-7} *7*; α(IPF)=1.026×10^{-5} *15* Additional information 5. (1213γ)(882γ)(θ): A_2=+0.108 *23*, A_4=+0.01 *4*. δ(M3/E2)=+0.01 *4*.
1255.5[@] *6*	0.11 *2*	3878.7	(2$^+$,3)	2623.01	2$^+$				
1438.0[@] *7*	0.15 *4*	3927.30	1$^-$	2489.2	(2$^+$,3$^-$)				
1463.8 *7*	4.7 *9*	2345.24	4$^+$	881.61	2$^+$	(E2)		0.000288 *4*	α=0.000288 *4*; α(K)=0.000193 *3*; α(L)=2.03×10^{-5} *3*; α(M)=3.29×10^{-6} *5*; α(N+..)=7.23×10^{-5} *11* α(N)=3.32×10^{-7} *5*; α(IPF)=7.20×10^{-5} *11* Additional information 7. (1464γ)(882γ)(θ): A_2=+0.078 *26*, A_4=+0.03 *7*. δ(M3/E2)=−0.04 *4*.
1534.7[@] *6*	0.24 *5*	3878.7	(2$^+$,3)	2345.24	4$^+$				
1578.1 *4*	1.6 *3*	3475.57	(1$^-$)	1897.63	2$^+$				Additional information 21.
1607.6 *4*	0.95 *15*	2489.2	(2$^+$,3$^-$)	881.61	2$^+$				Additional information 8.
1741.2 *4*	3.9 *6*	2623.01	2$^+$	881.61	2$^+$	(M1+E2)	−1.10 *23*	0.000327 *6*	α=0.000327 *6*; α(K)=0.0001367 *20*; α(L)=1.436×10^{-5} *21*; α(M)=2.32×10^{-6} *4*; α(N+..)=0.000173 α(N)=2.35×10^{-7} *4*; α(IPF)=0.000173 *5* Additional information 9. (1741γ)(882γ)(θ): A_2=+0.43 *4*, A_4=+0.16 *7*.
[x]1779.6[@] *7*	0.15 *4*								

$^{84}_{36}Kr_{48}$-4

^{84}Br β^- decay (31.76 min) 1972Hi03,1970Ha21,1980Sa10 (continued)

$\gamma(^{84}Kr)$ (continued)

E_γ ‡	I_γ ‡&	E_i(level)	J_i^π	E_f	J_f^π	Mult.#	δ#	α†	Comments
1807.8@ *8*	0.10 *3*	3705.76	$1^{(-)},2,3^{(-)}$	1897.63	2^+				E_γ: from coin with 1898γ.
1818.7@ *4*	0.58 *9*	2699.93	3^-	881.61	2^+				
1877.5 *4*	2.7 *4*	2759.1	2^+	881.61	2^+	(M1+E2)	−0.10 *8*	0.000345 *5*	α=0.000345 *5*; α(K)=0.0001184 *17*; α(L)=1.241×10^{-5} *18*; α(M)=2.01×10^{-6} *3*; α(N+..)=0.000212 α(N)=2.04×10^{-7} *3*; α(IPF)=0.000212 *3* Additional information 13. (1877γ)(882γ)(θ): A_2=+0.32 *5*, A_4=+0.01 *8*.
1897.6 *2*	35 *4*	1897.63	2^+	0.0	0^+				Additional information 4.
2029.6 *5*	5.0 *10*	3927.30	1^-	1897.63	2^+				Additional information 26.
2094.2@ *5*	0.51 *10*	4189.2?	$(2^+,3)$	2094.95	4^+				
2200.7 *4*	2.8 *4*	3082.01	3	881.61	2^+				Additional information 18.
2218.5@ *12*	0.16 *8*	4116.8	$1^-,2^-$	1897.63	2^+				E_γ,I_γ: from coin with 1898γ.
2484.1 *3*	16.0 *16*	3365.85	$(1,2^+)$	881.61	2^+	D+Q			Additional information 19. (2484γ)(882γ)(θ): A_2=−0.252 *28*, A_4=+0.05 *4*. δ: +0.002 *30* for J=1, +0.79 *15* for J=2.
2593.7@ *6*	0.33 *7*	3475.57	(1^-)	881.61	2^+				
2622.9@ *5*	0.72 *15*	2623.01	2^+	0.0	0^+				
2758.7 *5*	1.17 *20*	2759.1	2^+	0.0	0^+				Additional information 14.
2824.1 *4*	2.7 *4*	3705.76	$1^{(-)},2,3^{(-)}$	881.61	2^+				Additional information 25.
2988.7@ *7*	0.42 *10*	3870.4	1,2,3	881.61	2^+				
3045.4 *4*	6.0 *9*	3927.30	1^-	881.61	2^+				Additional information 27.
3202.1@ *7*	0.50 *10*	4084.3	$(1,2^+)$	881.61	2^+				
3235.3 *5*	4.9 *8*	4116.8	$1^-,2^-$	881.61	2^+				Additional information 30.
3365.8 *4*	6.9 *10*	3365.85	$(1,2^+)$	0.0	0^+				Additional information 20.
3927.5 *4*	16.3 *17*	3927.30	1^-	0.0	0^+				Additional information 28. Mult.: Measured anisotropy [Iγ(0°)/Iγ(90°)]−1=0.59 *6* at 8.5 mK (1992Pr06) in NMR work on oriented nuclei.
4084.6 *6*	0.66 *10*	4084.3	$(1,2^+)$	0.0	0^+				Additional information 29.
4115.8@ *15*	0.0093 *20*	4116.8	$1^-,2^-$	0.0	0^+				

† Additional information 31.
‡ From 1972Hi03. Corresponding values from 1970Ha21 are in good agreement but are somewhat less precise and are not as complete. Also no energy uncertainties are quoted by 1970Ha21. For this reason all γ-ray data are taken from 1972Hi03. The data from 1970Ha21 are given under document records.
# From $\gamma\gamma(\theta)$ (1980Sa10). Parity from adopted $\Delta\pi$.
@ This γ ray reported only by 1972Hi03.
& For absolute intensity per 100 decays, multiply by 0.416 *31*.
[a] Multiply placed.

$^{84}_{36}Kr_{48}$-5

$\gamma(^{84}Kr)$ (continued)

[b] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

^{84}Br β^- decay (31.76 min) 1972Hi03,1970Ha21,1980Sa10

Decay Scheme

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

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)
- Coincidence
- Coincidence (Uncertain)

2^- 0 31.76 min *8*

Q_{β^-}=4629 *15* $\%\beta^-$=100.0

$^{84}_{35}Br_{49}$

Iβ⁻	Log *ft*		
0.21	5.9	$(2^+,3)$	4189.2
2.1	5.1	$1^-,2^-$	4116.8
0.48	5.84	$(1,2^+)$	4084.3
11.5	4.85	1^-	3927.30
0.29	6.56	$(2^+,3)$	3878.7
0.17	6.8	1,2,3	3870.4
2.5	5.95	$1^{(-)},2,3^{(-)}$	3705.76
0.49	7.0	(1^-)	3475.57
9.4	5.89	$(1,2^+)$	3365.85
3.9	6.62	3	3082.01
1.12	7.5	2^+	2759.1
7.3	6.74	3^-	2699.93
1.7	7.4	2^+	2623.01
0.33	8.3	$(2^+,3^-)$	2489.2
<0.9	>9.1 1u	4^+	2345.24
<0.4	>9.8 1u	4^+	2094.95
11.7	7.2	2^+	1897.63
13.5	7.70	2^+	881.61
33	9.46 1u	0^+	0.0 stable

2094.2 0.21; 4115.8 0.0039; 3235.3 2.0; 2218.5 0.07; 4084.6 0.27; 3202.1 0.21; 3927.5 6.8; 3045.4 2.5; 2029.6 2.1; 1438.0 0.062; 561.4 0.083; 1534.7 0.100; 1255.5 0.050; 1119.1 0.14; 2988.7 0.17; 394.1; 2824.1 1.12; 1807.8 0.042; 1082.6 0.14; 1005.7 0.46; 947.5 0.35; 339.8 [D,E2] 0.071; 230.2 [D,E2] 0.31; 2593.7 0.14; 1578.1 0.67; 394.1

$^{84}_{36}Kr_{48}$

^{84}Br β^- decay (31.76 min) 1972Hi03,1970Ha21,1980Sa10

Decay Scheme (continued)

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