^{81}Se β^- decay (18.5 min) 1969Zo06,1971Do09,2015Kr02

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	M. Shamsuzzoha Basunia	NDS 199,271 (2025)	1-Sep-2024

Parent: ^{81}Se: E=0; $J^\pi=1/2^-$; $T_{1/2}$=18.5 min *1*; Q(β^-)=1588.0 *14*; %β^- decay=100

^{81}Se-J^π,$T_{1/2}$: from ^{81}Se Adopted Levels.

^{81}Se-Q(β^-): from 2021Wa16.

Others: 1960Ku06, 1962Su07, 1963Ar01, 1967Pr06, 1967Yt03, 1969Ba34, 1969Be82, 1971Na18, 1974Ve12, 1974SaYH, 1977Kr18.

1969Zo06: chemically separated Se from ^{80}Se(n,γ) (99.87% ^{80}Se); measured Eγ, Iγ with Ge(Li), FWHM=2.5 keV at Eγ=1332, and $\gamma\gamma$ coin with Ge(Li) and NaI, FWHM=7.0 keV at Eγ=1332.

1971Do09: source from ^{82}Se(γ,n) (89.1% ^{82}Se target); measured Eγ, Iγ, $\gamma\gamma$ coin, γ(t); Ge(Li) (FWHM=3.6 keV at 1 MeV) and, for Eγ<300, x-ray Ge(Li) spectrometer (FWHM=0.8 keV at 50 keV, 1.3 keV at 300 keV).

2015Kr02: ^{nat}Se targets were irradiated using rabbit system in the core of the Oregon State University TRIGA reactor. γ rays were detected with high-resolution Ge detectors (efficiency of 35% and FWHM=1.9 keV at 1332 keV). Measured Eγ, Iγ. Deduced levels, β feedings and log *ft* values.

1974Ve12: source from ^{80}Se(n,γ) E=thermal (96.87% ^{80}Se target); measured Eγ, Iγ; Ge(Li) FWHM=4 keV at 662 keV. ΔE(γ) not given; no isomeric assignment made for observed γ rays.

^{81}Br Levels

The adopted decay scheme is based on those from 1969Zo06 and 1971Do09, with minor revisions by the evaluator. The tentative 815 level (deexcited by an 815γ) and the 1352 level (deexcited by 1352γ and 787γ), proposed by 1974Ve12 without the benefit of coin information, are not adopted by the evaluator. The 787γ presumably corresponds to the weak lines reported at 789.2 *5* and 787 *2* by 1971Do09 and 1969Zo06, respectively, and that Eγ implies E(level)=1354.5 *5* which does not fit the 1352γ well. An Eγ=789.6 *7* line in (p,γ) is placed as the major branch from a 1327 level, and the evaluator tentatively introduces this level into the decay scheme to accommodate the 789.2γ of 1971Do09. The evaluator also tentatively introduces the known 1105 level (J^π=1/2$^-$, 3/2$^-$) to accommodate the weak unplaced 1105 *1* γ from 1971Do09. Eγ=30 reported in 1962Su07 is not confirmed in 1967Ra08.

E(level)†	J^π‡	$T_{1/2}$‡	Comments
0	3/2$^-$		
275.986 *9*	5/2$^-$	9.7 ps *14*	$T_{1/2}$: 235 ps *15* from 290γ-276γ(t) (1974SaYH). Inconsistent with adopted value (9.7 ps *14*) for reasons which are unknown.
538.194 *14*	1/2$^-$,3/2$^-$	0.76 ps *3*	J^π: proposed spin and parity 5/2$^-$ or 7/2$^-$ in 1967Ra08.
566.125 *11*	3/2$^-$	68 ps *+32−18*	
650.003 *16*	(3/2)$^-$	2.6 ps *3*	
828.434 *15*	3/2$^-$	0.46 ps *7*	
835.5 *5*	7/2$^-$	1.05 ps *7*	E(level): level proposed in 1977Kr18. Absent in other references.
1105? *1*	(1/2)$^-$		
1327.3? *5*			

† From a least-squares fit to Eγ.

‡ From Adopted Levels.

β^- radiations

β^- av Eβ: Additional information 2.

Continued on next page (footnotes at end of table)

^{81}Se β^- decay (18.5 min) 1969Zo06,1971Do09,2015Kr02 (continued)

β^- radiations (continued)

E(decay)	E(level)	Iβ^-[†‡]	Log *ft*	Comments
(260.7[#] *18*)	1327.3?	≤0.0025	≥6.8	av Eβ=74.46 *48* Iβ⁻: 0.0025 *4* from γ transition intensity balance. The evaluator proposed the limit for I_β, since isomeric assignment of Iγ(789.1γ) was not determined in 1969Zo06. A comparable 789.254γ also reported in ^{81}Se β- decay (57.28 m) from 2015Kr02.
(759.6 *17*)	828.434	0.41 *4*	6.188 *43*	av Eβ=257.8 *6* Iβ⁻: other: 0.61 *5%* in 1967Ra08.
(938.0 *17*)	650.003	0.0191 *18*	7.857 *41*	av Eβ=330.8 *6*
(1021.9 *17*)	566.125	0.78 *7*	6.386 *39*	av Eβ=366.1 *6* Iβ⁻: other: 0.92 *5%* in 1967Ra08. E(decay): 1010 (1960Ku06).
(1049.8 *17*)	538.194	0.032 *7*	7.80 *9*	av Eβ=377.9 *6*
(1312.0 *17*)	275.986	≤0.013	≥9.3	av Eβ=509.8 *6* Iβ⁻: 0.013 *9* from γ transition intensity balance. The evaluator proposed the limit for I_β, since Iγ(275.99γ) may contain negligible intensity resulting from the feeding in ^{81}Se β- decay (57.28 m).
(1588.0 *20*)	0	98.74 *12*	5.0283 *29*	av Eβ=614.2 *6* E(decay): measured endpoint energy 1580 *40*: weighted average of 1560 *50* (1960Ku06) and 1600 *50* (1967Yt03). Iβ⁻: 100%-Σ(I(γ+ce) to g.s.). Other: 98.5 *1%* in 1967Ra08.

† From total transition intensity balance at each level. Values of 1967Ra08 are listed in comments, estimated from measured Iγ, the total number of 18-min ^{81g}Se disintegrations was obtained by using a total conversion coefficient of α=7.07 for the 102.7-keV isomeric transition, and a value of 0.68, from $[(T_p-T_d)/T_p]$, for the ratio of ^{81m}Se/^{81g}Se activities at equilibrium.

‡ Absolute intensity per 100 decays.

Existence of this branch is questionable.

^{81}Se β^- decay (18.5 min) 1969Zo06,1971Do09,2015Kr02 (continued)

$\gamma(^{81}Br)$

Iγ normalization: using equation [8] of 2020Ba30 in transient equilibrium of ^{81m}Se (57.28 m *2*) and ^{81}Se (18.5 m *1*), where Iγ(103γ, ^{81}Se IT)/I(276γ, ^{81}Br)=12.9 *9* for ^{81}Se source in transient equilibrium (weighted average of 12.2 *14* (using data in 1969Zo06) and 13.6 *15* (using data in 1971Do09)), and %Iγ(102.968)=12.8 *2*.
Authors, typically, have employed ^{81}Se sources in which the 57-min and 18-min isomers are in transient equilibrium, and quote Iγ relative to Iγ=100 for the 103γ in ^{81}Se (57 min) IT decay. Following 1969Zo06 and 1971Do09, the evaluator has deduced I(276γ) appropriate to ^{81}Se (18 min) decay alone using the measured I(276γ) for ^{81}Se (57 min+18 min) decay and I(260γ) (present in ^{81}Se (57 min) decay only), assuming α(260γ)=0.0456 and α(276γ)=0.008; Iγ data from 1969Zo06, 1971Do09 and 1974Ve12 were then renormalized so I(276γ, 18-m Se)=100. These data are then in excellent agreement among themselves and with Iγ obtained by 1969Zo06 by resolving the decay curve for each γ into its two components.
α(K)exp, α(L)exp data are from 1971Na18, measured with Ge(Li) γ detector and Si(Li) electron spectrometer, calibrated using transitions with well-known α(K) and α(L).
$\gamma\gamma(\theta)$ data: for 290γ-276$\gamma(\theta)$, A_2=+0.050 *35* (1963Ar01), +0.052 *20* (1969Be82) and A_4=+0.031 *5* (1963Ar01), +0.08 *7* (1969Be82). Weighted averages of data are A_2=+0.052 *17*, A_4=+0.031 *5*; these allow δ(290γ) and δ(276γ) to be −8 *+4−17* and +0.262 *20*, or −0.262 *20* and +8 *+17−4*, or +0.258 *23* and −7.5 *+6−7*, or +7.5 *+7−6* and −0.258 *23*, none of which is consistent with adopted values of +1.08 *18* and −0.10 *3*, respectively.

E_γ[‡]	I_γ[‡][b]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	α[†]	Comments
178.416 *24*	0.92 *4*	828.434	3/2$^-$	650.003	(3/2)$^-$	(M1+E2)	<0.28	0.0274 *31*	α(K)exp<0.05; α(L)exp<0.003 α(K)=0.0243 *27*; α(L)=0.00269 *34*; α(M)=0.00043 *5* α(N)=3.9×10^{-5} *5* E_γ: weighted average of 178.3 *1* (1969Zo06), 177.9 *3* (1971Do09), 178.424 *20* (2015Kr02), 178.4 *1* (1977Kr18). I_γ: weighted average of 0.98 *10* (1969Zo06), 0.80 *8* (1971Do09, recalculated by evaluator), 0.94 *4* (2015Kr02), 0.93 *6* (1977Kr18). Mult.: E1 or M1(+E2), based on α(K)exp alone. If M1+E2, δ<0.28 from α(L)exp, <0.84 from α(K)exp.
275.990 *10*	100 *1*	275.986	5/2$^-$	0	3/2$^-$	M1+E2	−0.10 *3*	0.00816 *14*	α(K)exp=0.009 *1*; α(L)exp=0.002 *1* α(K)=0.00724 *13*; α(L)=0.000781 *14*; α(M)=0.0001242 *23* α(N)=1.158×10^{-5} *21* E_γ: weighted average of 275.94 *5* (1969Zo06), 275.9 *1* (1971Do09), 275.6 *3* (1969Ba34), 275.8 *5* (1967Ra08), and 275.993 *10* (2015Kr02). I_γ: from 2015Kr02. Others: 100 (1969Zo06), 100 (1971Do09), 100 *3* (1969Ba34 − rescaling 10.2 *3*), 100 *5* (1967Ra08 − rescaling 10.2 *5*). δ: 0.45 *+14−15* from α(K)exp and α(L)exp, but datum probably too imprecise to be reliable.
290.1[@] *1*	2.4[@] *5*	828.434	3/2$^-$	538.194	1/2$^-$,3/2$^-$				E_γ: weighted average of 290.1 *1* (1969Zo06), 290.0 *7*

^{81}Se β^- decay (18.5 min) 1969Zo06,1971Do09,2015Kr02 (continued)

$\gamma(^{81}Br)$ (continued)

E_γ[‡]	I_γ[‡b]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	α[†]	Comments
									(1971Do09), 289.9 *3* (1969Ba34), 290.0 *5* (1977Kr18), 289.9 *5* (1967Ra08). I_γ: weighted average of 1.9 *5* (1969Zo06), 2.5 *5* (1971Do09), 3.2 *8* (1977Kr18).
290.138[@] *13*	84.2[@] *8*	566.125	3/2$^-$	275.986	5/2$^-$	E2+M1	+1.11 *22*	0.0131 *12*	A_2=0.052 *20*; A_4=0.08 *7* (1970Be79) α(K)exp=0.012 *1*; α(L)exp=0.002 *1* α(K)=0.0115 *11*; α(L)=0.00130 *12*; α(M)=0.000205 *20* α(N)=1.87×10^{-5} *17* E_γ: weighted average of 290.08 *5*(1969Zo06), 289.9 *1* (1971Do09), 290.141 *10*(2015Kr02), 290.19 *5* (1977Kr18), 289.9 *5* (1967Ra08), 289.9 *3* (1969Ba34). In 1969Ba34, authors could not prove it as doublet. I_γ: weighted average of 82 *8* (1969Zo06), 82 *9* (1971Do09), 84.3 *8* (2015Kr02), 87 *4* (1977Kr18), 85 *4* (1967Ra08 – for both placement – rescaling 8.7 *4*), 82 *3* (1969Ba34 – rescaling 8.4 *3*). In 1969Ba34, authors could not prove it as doublet. δ: 1.23 *22* from α(K)exp, >0.64 from α(L)exp.
538.189 *14*	7.18 *7*	538.194	1/2$^-$,3/2$^-$	0	3/2$^-$	M1+E2	0.087 *15*	1.63×10^{-3} *2*	α(K)=0.001454 *20*; α(L)=0.0001541 *22*; α(M)=2.448×10^{-5} *34* α(N)=2.293×10^{-6} *32* E_γ: weighted average of 538.2 *1* (1969Zo06), 538.2 *2* (1971Do09), 538.0 *4* (1969Ba34), 539.0 *5* (1967Ra08), 538.188 *14* (2015Kr02), 538.2 *1* (1977Kr18). I_γ: from 2015Kr02. Others: 6.9 *7* (1969Zo06), 7.7 *8* (1971Do09), 6.3 *16* (1969Ba34 – rescaling 0.64 *16*), 7.8 *20* (1967Ra08 – rescaling 0.8 *2*), 7.3 *4* (1977Kr18).
552.455 *14*	13.6 *1*	828.434	3/2$^-$	275.986	5/2$^-$	M1+E2	+0.32 *20*	0.00160 *8*	α(K)=0.00142 *7*; α(L)=0.000151 *8*; α(M)=2.40×10^{-5} *13* α(N)=2.24×10^{-6} *12* E_γ: 552.4 *1* (1969Zo06), 552.5 *2* (1971Do09), 552.1 *4* (1969Ba34), 553.0 *5* (1967Ra08), 552.456 *14* (2015Kr02), 552.44 *8* (1977Kr18). I_γ: weighted average of 12.5 *12* (1969Zo06), 13.6 *14* (1971Do09), 13.2 *20* (1969Ba34 – rescaling 1.35 *20*), 14.7 *29* (1967Ra08 – rescaling 1.5 *3*), 13.6 *1* (2015Kr02), 13.6 *9* (1977Kr18).
566.123 *14*	31.8 *3*	566.125	3/2$^-$	0	3/2$^-$	M1+E2	−3.0 *5*	0.00199 *4*	α(K)=0.001763 *32*; α(L)=0.0001908 *35*; α(M)=3.03×10^{-5} *6*

$^{81}_{35}Br_{46}$-4

^{81}Se β^- decay (18.5 min) 1969Zo06,1971Do09,2015Kr02 (continued)

$\gamma(^{81}Br)$ (continued)

E_γ[‡]	I_γ[‡][b]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	α[†]	Comments
									α(N)=2.80×10^{-6} *5* E_γ: weighted average of 566.04 *5* (1969Zo06), 565.9 *2* (1971Do09), 566.0 *4* (1969Ba34), 566.1 *5* (1967Ra08), 566.131 *14* (2015Kr02), 566.11 *7* (1977Kr18). Other: 552 and 560 (1962Su07). I_γ: weighted average of 33.0 *33* (1969Zo06), 32.5 *50* (1971Do09), 29.9 *29* (1969Ba34 – rescaling 3.05 *30*), 28.4 *29* (1967Ra08 – rescaling 2.9 *3*), 31.8 *3* (2015Kr02), 33.3 *15* (1977Kr18). Other: 37 *8* for doublet 552 and 560 (1962Su07).
649.990 *19*	3.79 *4*	650.003	(3/2)$^-$	0	3/2$^-$	M1+E2	+0.111 *7*	1.07×10^{-3} *2*	α(K)=0.000950 *13*; α(L)=0.0001003 *14*; α(M)=1.593×10^{-5} *22* α(N)=1.493×10^{-6} *21* E_γ: weighted average of 649.8 *1* (1969Zo06), 649.7 *3* (1971Do09), 649.996 *14* (2015Kr02), 649.9 *1* (1977Kr18). I_γ: weighted average of 3.5 *4* (1969Zo06), 4.0 *4* (1971Do09), 3.79 *4* (2015Kr02), 4.00 *35* (1977Kr18).
789.1[&][c] *5*	0.38 *5*	1327.3?		538.194	1/2$^-$,3/2$^-$				E_γ: weighted average of 787 *2* (1969Zo06), 789.2 *5* (1971Do09), 789.2 *7* (1977Kr18 – not placed in the level scheme). I_γ: weighted average of 0.4 *1* (1969Zo06) and 0.38 *5* (1974Ve12 – rescaled Iγ=0.039 *5* (in level scheme) relative to Iγ(275.990)=100 instead of 10.23, Iγ=0.930 *5* in Table I appears to be a misprint). Other: < 0.2 (2015Kr02).
828.33 *17*	43.5 *5*	828.434	3/2$^-$	0	3/2$^-$	M1+E2	+0.18 *3*	6.29×10^{-4} *9*	α(K)=0.000560 *8*; α(L)=5.89×10^{-5} *8*; α(M)=9.35×10^{-6} *13* α(N)=8.77×10^{-7} *12* E_γ: unweighted average of 828.27 *5* (1969Zo06), 828.2 *2* (1971Do09), 827.7 *3* (1969Ba34), 829.0 *5* (1967Ra08), 828.432 *14* (2015Kr02), and 828.37 *15* (1977Kr18). Other: 832 (1962Su07). I_γ: weighted average of 40.2 *40* (1969Zo06), 43.9 *44* (1971Do09), 40 *5* (1969Ba34 – rescaling 4.1 *5*), 25 *6* (1962Su07), 48 *5* (1967Ra08 – rescaling 4.9 *5*), 43.6 *4* (2015Kr02), 44 *2* (1977Kr18).
835.5 *5*	0.11 *5*	835.5	7/2$^-$	0	3/2$^-$	E2		7.08×10^{-4} *10*	α(K)=0.000629 *9*; α(L)=6.70×10^{-5} *9*; α(M)=1.063×10^{-5} *15* α(N)=9.89×10^{-7} *14* E_γ,I_γ: from 1977Kr18. Other: 835 *2* – reported in 1969Zo06, however, comparable 834.1γ was expected from contaminant ^{83}Se, an upper limit Iγ <0.0003% was reported for this γ.
1105[c] *1*		1105?	(1/2)$^-$	0	3/2$^-$	D			E_γ: weak γ, isomeric assignment not established (1971Do09); placed by evaluator.

$^{81}_{35}Br_{46}$-5

^{81}Se β^- decay (18.5 min) 1969Zo06,1971Do09,2015Kr02 (continued)

$\gamma(^{81}Br)$ (continued)

E_γ [‡]	I_γ [‡b]	E_i(level)	Comments
[x]1352[a]	0.21 *7*		

† Additional information 3.
‡ Weighted average of available data as listed in comments, except as noted. Iγ is photon intensity relative to I(276γ, 18-m ^{81}Se)=100. Weak γ rays with Eγ=375 (Iγ=0.54 *6*) and Eγ=815 (Iγ=0.11 *6*) on the intensity scale used here are reported by 1974Ve12 (isotopic assignment unknown) and tentatively placed from 650 and 815 levels, respectively, but these gammas are absent in both 1969Zo06 and 1971Do09, so are omitted here.
# From Adopted Gammas, except as noted.
@ Doublet. Iγ divided based on $\gamma\gamma$ coin. Energy separation of components is <0.7 keV (1971Do09) so averaged energy of doublet (290.04 *7*) is assigned to the stronger component and Eγ=290.0 *7* (suggested by 1971Do09) to the weaker one.
& Tentatively placed by evaluator by analogy with (p,γ); placed by 1974Ve12 from a tentative 1352 level which the evaluator does not adopt, but not placed by 1969Zo06, 1971Do09. Isomeric assignment not established.
[a] Reported by 1974Ve12 only and placed from a 1352 level which the evaluator does not adopt. This γ must be different from the 1350γ deexciting the 1350-keV level in (n,n$'\gamma$), because the stronger 327γ and 583γ which also deexcite that level in (n,n$'\gamma$) are not seen by 1974Ve12. This γ may not belong to ^{81}Se β^- decay.
[b] For absolute intensity per 100 decays, multiply by 0.0067 *5*.
[c] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

$^{81}_{35}Br_{46}$-6

^{81}Se β^- decay (18.5 min) 1969Zo06,1971Do09,2015Kr02

Decay Scheme

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