^{81}Se β^- decay (18.45 min) 1969Zo06,1971Do09

History			
Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Coral M. Baglin	NDS 109, 2257 (2008)	15-Aug-2008

Parent: ^{81}Se: E=0; $J^\pi=1/2^-$; $T_{1/2}$=18.45 min *12*; Q(β^-)=1585.3 *22*; %β^- decay=100.0

Others: 1960Ku06, 1963Ar01, 1967Pr06, 1967Yt03, 1969Be82, 1971Na18, 1974Ve12, 1974SaYH.

1969Zo06: chemically separated Se from ^{80}Se(n,γ) (99.87% ^{80}Se); measured Eγ, Iγ withGe(Li), FWHM=2.5 keV at Eγ=1332, and $\gamma\gamma$ coin withGe(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-rayGe(Li) spectrometer (FWHM=0.8 keV at 50 keV, 1.3 keV at 300 keV).

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 ($J^\pi=1/2^-$, $3/2^-$) to accommodate the weak unplaced 1105 *1* γ from 1971Do09.

E(level)[†]	J^π[‡]	$T_{1/2}$	Comments
0	$3/2^-$		
275.93 *4*	$5/2^-$	235 ps *15*	$T_{1/2}$: from 290γ-276γ(t) (1974SaYH). Inconsistent with adopted value (9.7 ps *14*) for reasons which are unknown.
538.20 *9*	$1/2^-$,$3/2^-$		
566.01 *5*	$3/2^-$		
649.87 *8*	$(3/2)^-$		
828.27 *5*	$3/2^-$		
1105? *1*	$(1/2)^-$		
1327.3? *5*			

[†] From least-squares fit to Eγ.
[‡] From Adopted Levels.

β^- radiations

E(decay)	E(level)	Iβ^-[‡]	Log *ft*	Comments
(258.0[#] *23*)	1327.3?	≤0.0029	≥6.7	av Eβ=74.25 *73* Iβ^-: 0.0029 *4* from intensity balance.
(757.0 *22*)	828.27	0.40 *4*	6.18 *5*	av Eβ=257.74 *89*
(935.4 *22*)	649.87	0.0196 *25*	7.83 *6*	av Eβ=330.80 *92*
1010	566.01	0.79 *8*	6.36 *5*	av Eβ=366.05 *94* E(decay): from 1960Ku06.
(1047.1 *22*)	538.20	0.034 *5*	7.77 *7*	av Eβ=377.85 *94*
1580[†] *40*	0	98.73 *10*	5.010 *4*	av Eβ=614.4 *10* Iβ^-: 100%-Σ(I(γ+ce) to g.s.).

[†] Measured endpoint energy; weighted average of 1560 *50* (1960Ku06) and 1600 *50* (1967Yt03).

Continued on next page (footnotes at end of table)

^{81}Se β^- decay (18.45 min) 1969Zo06,1971Do09 (continued)

β^- radiations (continued)

‡ Absolute intensity per 100 decays.
# Existence of this branch is questionable.

^{81}Se β^- decay (18.45 min) 1969Zo06,1971Do09 (continued)

$\gamma(^{81}Br)$

Iγ normalization: 0.0068 *5* from I(103γ, ^{81}Se IT)/I(276γ, ^{81}Br)=12.9 *9* for ^{81}Se source in transient equilibrium (weighted average of 12.2 *12* (1969Zo06) and 13.6 *14* (1971Do09)), assuming α(103γ)=6.79 and adopted $T_{1/2}$ for ^{81}Se isomers.

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 withGe(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[†a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	δ[‡]	α[b]	Comments
178.26 *12*	0.85 *8*	828.27	3/2$^-$	649.87	(3/2)$^-$	(M1+E2)	<0.29	0.027 *3*	α(K)exp<0.05; α(L)exp<0.003 α(K)=0.024 *3*; α(L)=0.0027 *4*; α(M)=0.00043 *6*; α(N+..)=4.0×10^{-5} *5* α(N)=4.0×10^{-5} *5* Eγ(Iγ) data: 178.3 *1* (0.98 *10*) (1969Zo06), 177.9 *3* (0.80 *8*) (1971Do09, recalculated by evaluator). Mult.: E1 or M1(+E2), based on α(K)exp alone. If M1+E2, δ<0.29 from α(L)exp, <0.83 from α(K)exp.
275.93 *4*	100	275.93	5/2$^-$	0	3/2$^-$	M1+E2	−0.10 *3*	0.00816 *15*	α(K)exp=0.009 *1*; α(L)exp=0.002 *1* α(K)=0.00725 *13*; α(L)=0.000782 *15*; α(M)=0.0001242 *23*; α(N+..)=1.159×10^{-5} *21* α(N)=1.159×10^{-5} *21* Eγ(Iγ) data: 275.94 *5* (100) (1969Zo06), 275.9 *1* (100) (1971Do09). δ: 0.43 *+13−15* from α(K)exp; δ>0.45 from α(L)exp, but datum probably too imprecise to be reliable.
290.0[#] *7*	2.2[#] *4*	828.27	3/2$^-$	538.20	1/2$^-$,3/2$^-$				I_γ: 1.9 *5* (1969Zo06), 2.5 *5* (1971Do09).
290.04[#] *7*	82[#] *6*	566.01	3/2$^-$	275.93	5/2$^-$	E2+M1	+1.08 *18*	0.0129 *10*	α(K)exp=0.012 *1*; α(L)exp=0.002 *1* α(K)=0.0114 *9*; α(L)=0.00128 *11*; α(M)=0.000203 *17*; α(N+..)=1.85×10^{-5} *15* α(N)=1.85×10^{-5} *15* Eγ(Iγ) data: 290.08 *5* (82 *8*) (1969Zo06), 289.9 *1* (82 *9*) (1971Do09). δ: 1.22 *+32−23* from α(K)exp, >0.64 from α(L)exp.

$^{81}_{35}Br_{46}$-3

^{81}Se β^- decay (18.45 min) 1969Zo06,1971Do09 (continued)

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

E_γ [†]	I_γ [†a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	δ[‡]	α[b]	Comments
538.20 *9*	7.2 *5*	538.20	1/2$^-$,3/2$^-$	0	3/2$^-$	M1+E2	0.088 *16*	1.63×10^{-3}	α(K)=0.001454 *21*; α(L)=0.0001540 *22*; α(M)=2.45×10^{-5} *4*; α(N+..)=2.29×10^{-6} *4* α(N)=2.29×10^{-6} *4* Eγ(Iγ) data: 538.2 *1* (6.9 *7*) (1969Zo06), 538.2 *2* (7.7 *8*) (1971Do09).
552.42 *9*	13.0 *9*	828.27	3/2$^-$	275.93	5/2$^-$	M1+E2	+0.32 *20*	0.00160 *9*	α(K)=0.00142 *8*; α(L)=0.000151 *9*; α(M)=2.40×10^{-5} *14*; α(N+..)=2.24×10^{-6} *12* α(N)=2.24×10^{-6} *12* Eγ(Iγ) data: 552.4 *1* (12.5 *12*) (1969Zo06), 552.5 *2* (13.6 *14*) (1971Do09).
566.03 *5*	33.0 *26*	566.01	3/2$^-$	0	3/2$^-$	M1+E2	−3.0 *5*	0.00199 *4*	α(K)=0.00176 *4*; α(L)=0.000191 *4*; α(M)=3.03×10^{-5} *6*; α(N+..)=2.80×10^{-6} *5* α(N)=2.80×10^{-6} *5* Eγ(Iγ) data: 566.04 *5* (33 *3*) (1969Zo06), 565.9 *2* (33 *5*) (1971Do09).
649.79 *9*	3.75 *28*	649.87	(3/2)$^-$	0	3/2$^-$	M1+E2	+0.110 *7*	1.07×10^{-3}	α(K)=0.000951 *14*; α(L)=0.0001004 *14*; α(M)=1.594×10^{-5} *23*; α(N+..)=1.494×10^{-6} *21* α(N)=1.494×10^{-6} *21* Eγ(Iγ) data: 649.8 *1* (3.5 *4*) (1969Zo06), 649.7 *3* (4.0 *4*) (1971Do09).
789.1[@c] *5*	0.42 *5*	1327.3?		538.20	1/2$^-$,3/2$^-$				E_γ: 787 *2* (1969Zo06), 789.2 *5* (1971Do09). I_γ: weighted average of data from 1969Zo06 (0.4 *1*) and drawing in 1974Ve12 (0.42 *5*, based on Iγ=0.039 *5* relative to I(103γ)=100, misprinted as 0.930 *5* in table I of 1974Ve12).
828.27 *5*	42 *3*	828.27	3/2$^-$	0	3/2$^-$	M1+E2	+0.175 *26*	6.29×10^{-4}	α(K)=0.000560 *8*; α(L)=5.89×10^{-5} *9*; α(M)=9.35×10^{-6} *14*; α(N+..)=8.77×10^{-7} *13* α(N)=8.77×10^{-7} *13* Eγ(Iγ) data: 828.27 *5* (40 *4*) (1969Zo06), 828.2 *2* (44 *4*) (1971Do09).
1105[c] *1*		1105?	(1/2)$^-$	0	3/2$^-$	D			E_γ: weak γ, isomeric assignment not established (1971Do09); placed by evaluator.
[x]1352[&]	0.21 *7*								

[†] Weighted average of data from 1969Zo06 and 1971Do09, 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 γγ coin. Energy separation of components is <0.7 keV (1971Do09) so averaged energy of doublet (290.04 *7*) is assigned to the

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

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.

[&] 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.

[a] For absolute intensity per 100 decays, multiply by 0.0068 *5*.

[b] 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.

[c] Placement of transition in the level scheme is uncertain.

[x] γ ray not placed in level scheme.

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

^{81}Se β^- decay (18.45 min) 1969Zo06,1971Do09

Decay Scheme

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