^{78}Se(α,nγ) 1983Ka03,1984Do02

History

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

Other: 1980CaZT.
1983Ka03: Eα=10 MeV to 18 MeV, 97% ^{78}Se target; measured Eγ, Iγ, nγ and γγ coin, γ(θ) (θ=0°−90°, 15° steps), excit (12-18 MeV); Ge(Li), resolution=2.4-2.5 keV at 1.33 MeV, timing FWHM=14 ns.
1984Do02: Eα=27 MeV, 97.9% ^{78}Se target, pulsed beam; measured αγ delay.

^{81}Kr Levels

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$[&]	Comments
0	7/2$^+$ [@]		
49.57 *4*	9/2$^+$ [@]	3.9 ns *4*	
190.44 *7*	1/2$^-$ [@]		
456.7	5/2$^-$		
549.2	(5/2$^+$,3/2)		J$^\pi$: excitation function favors 3/2, decay mode favors 5/2. 549γ(θ) does not distinguish between ΔJ=1 and ΔJ=2, and 499.8γ(θ) is isotropic. Adopted value is 5/2$^+$.
608.4	3/2$^+$		J$^\pi$: 3/2 from isotropic 608.4γ angular distribution measurements and excitation function data (1983Ka03).
636.5	3/2$^-$		
700.6	5/2$^-$		
732.2	(7/2,5/2)$^+$		J$^\pi$: 683γ excit favors J=5/2 but γ(θ) favors ΔJ=1 to 9/2$^+$ and is inconsistent with ΔJ=2.
873.5	11/2$^+$		
902.7	7/2$^-$		J$^\pi$: 7/2 from 853γ and 903γ excit.
919.9	3/2$^{(-)}$		
934.1	11/2$^{(+)}$		
976.2	1/2$^{(+)}$ [#]		
976.3	13/2$^+$ [#]		
995.1	(3/2)		
1025.7	(3/2)		
1093.2?			
1206.7	(7/2,5/2)		
1239.0			
1348.8	9/2$^-$		
1394.7	5/2$^{(-)}$		
1442.8	9/2$^-$		
1607.7	13/2$^+$		
1841.7	13/2$^+$		
1993.6	15/2$^+$		
2069.1			
2135.6	17/2$^+$		
2166.1	13/2$^-$		
2191.4	(15/2$^+$)		
2217.0	(13/2$^+$)		
2363.0			
2420.2			
2533.6	(15/2)		
2699.7		<0.2 ns	Level reported in 1984Do02 only.

[†] From a least-squares fit to Eγ, assuming ΔEγ=1 keV.
[‡] Recommended values from 1983Ka03, based on γ(θ), γ excit and reaction systematics, except as noted.
[#] Angular distribution and excitation function of the 926.6γ suggest J^π=13/2$^+$, whereas 339.7γ(θ) suggests 1/2$^+$. Consequently, a 976-keV doublet is proposed by 1983Ka03.

Continued on next page (footnotes at end of table)

^{78}Se(α,nγ) 1983Ka03,1984Do02 (continued)

^{81}Kr Levels (continued)

[@] From Adopted Levels.
[&] From centroid shift of time curve (1984Do02).

γ(^{81}Kr)

E_γ[†]	I_γ[†]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	δ[#]	Comments
(49.57[‡] *4*)		49.57	9/2$^+$	0	7/2$^+$			
166.1		2699.7		2533.6	(15/2)			E_γ: from 1984Do02 only.
(190.44[‡] *7*)		190.44	1/2$^-$	0	7/2$^+$			
244.0	2.1 *10*	700.6	5/2$^-$	456.7	5/2$^-$	D+Q	+1.8 *+8−5*	A_2=+0.215 *22*; A_4=+0.04 *3*
283.4	<1.0	919.9	3/2$^{(-)}$	636.5	3/2$^-$			
339.7	1.40 *9*	976.2	1/2$^{(+)}$	636.5	3/2$^-$	D+Q		A_2=−0.04 *4*; A_4=+0.01 *5*
367.5	8.7 *3*	2533.6	(15/2)	2166.1	13/2$^-$	D		A_2=−0.262 *25*; A_4=−0.06 *3*
389.2	<1.0	1025.7	(3/2)	636.5	3/2$^-$			
446.1	25.9 *10*	636.5	3/2$^-$	190.44	1/2$^-$			A_2=+0.186 *22*; A_4=0.00 *3* May also deexcite the 903 level.
446.1		902.7	7/2$^-$	456.7	5/2$^-$			Possible doublet; principal placement is from 637 level.
456.7	44.1 *15*	456.7	5/2$^-$	0	7/2$^+$			E_γ: strong coin seen with 446.1γ deexciting the 637 level and feeding the 190.6 level. Therefore, the 456.7γ may be a doublet deexciting both the 457 and 1093 levels. A_2=+0.039 *25*, A_4=−0.03 *3*.
456.7[&]		1093.2?		636.5	3/2$^-$			See comment on the 457γ deexciting the 457 level.
499.8	5.40 *15*	549.2	(5/2$^+$,3/2)	49.57	9/2$^+$			A_2=−0.004 *25*; A_4=0.00 *3*
(510.4)		700.6	5/2$^-$	190.44	1/2$^-$			E_γ: the 510.4-keV transition is known from (p,nγ) reaction and decay studies. In (α,nγ), it could not be seen because it was masked by the intense annihilation peak, but its existence is confirmed indirectly by coin data.
538.4	3.7 *3*	995.1	(3/2)	456.7	5/2$^-$			A_2=+0.12 *4*; A_4=−0.01 *5*
538.4		1239.0		700.6	5/2$^-$			Possible doublet; principal placement is from 995 level.
549.1	16.1 *5*	549.2	(5/2$^+$,3/2)	0	7/2$^+$			A_2=+0.148 *21*; A_4=−0.027 *25* A_2, A_4 values indicate ΔJ=1 or 2.
569.2	1.60 *15*	1025.7	(3/2)	456.7	5/2$^-$	D(+Q)		A_2=−0.15 *5*; A_4=+0.13 *8*
608.4	8.7 *6*	608.4	3/2$^+$	0	7/2$^+$			A_2=−0.04 *5*; A_4=−0.01 *5*
631.1[&]	5.6 *3*	1607.7	13/2$^+$	976.3	13/2$^+$			
657.5	3.9 *2*	1206.7	(7/2,5/2)	549.2	(5/2$^+$,3/2)	D+Q		A_2=−0.568 *25*; A_4=+0.052 *24*
673.6	16.7 *5*	1607.7	13/2$^+$	934.1	11/2$^{(+)}$	D+Q	−0.89 *+30−20*	A_2=−0.91 *3*; A_4=+0.097 *17*
682.6	11.2 *4*	732.2	(7/2,5/2)$^+$	49.57	9/2$^+$			A_2=−0.220 *24*; A_4=−0.02 *3* Mult.: A_2, A_4 implies D(+Q) but this is inconsistent with adopted J=(5/2) for the 732 level.
694.1	4.9 *7*	1394.7	5/2$^{(-)}$	700.6	5/2$^-$			A_2=+0.18 *12*; A_4=−0.07 *15*
723.0	3.4 *2*	2166.1	13/2$^-$	1442.8	9/2$^-$	Q		A_2=+0.61 *4*; A_4=−0.22 *5*
729.4	12.4 *4*	919.9	3/2$^{(-)}$	190.44	1/2$^-$	D		A_2=−0.28 *3*; A_4=0.00 *3*
732.2[&]	<7.1	732.2	(7/2,5/2)$^+$	0	7/2$^+$			E_γ,I_γ: possibly a g.s. transition exists but is masked in (α,nγ) by a more intense 729.3γ. Iγ=6.7 *4* for observed line.
742.4	15.9 *5*	1442.8	9/2$^-$	700.6	5/2$^-$	Q		A_2=+0.393 *23*; A_4=−0.12 *3*
758.1	≤1.0	1394.7	5/2$^{(-)}$	636.5	3/2$^-$			

$^{81}_{36}$Kr$_{45}$-3

γ(^{81}Kr) (continued)

E_γ [†]	I_γ [†]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [#]	δ [#]	α [@]	Comments
817.2	7.0 *3*	2166.1	13/2⁻	1348.8	9/2⁻	Q			A_2=+0.42 *6*; A_4=−0.14 *8*
824.0	30.8 *5*	873.5	11/2⁺	49.57	9/2⁺	D+Q	−0.8 *+4−6*		A_2=−0.50 *3*; A_4=+0.02 *3*
835.0	3.0 *5*	1025.7	(3/2)	190.44	1/2⁻				A_2=+0.14 *11*; A_4=+0.01 *13*
853.0	10.0 *5*	902.7	7/2⁻	49.57	9/2⁺	D			A_2=−0.157 *23*; A_4=−0.08 *3*
873.6	18.7 *6*	873.5	11/2⁺	0	7/2⁺	Q			A_2=+0.355 *23*; A_4=−0.13 *3*
884.6	61.0 *20*	934.1	11/2$^{(+)}$	49.57	9/2⁺	D+Q	−0.73 *+25−47*		A_2=−0.86 *3*; A_4=+0.098 *20*
892.1	11.4 *5*	1348.8	9/2⁻	456.7	5/2⁻	Q			A_2=+0.42 *4*; A_4=−0.13 *4*
902.6	9.2 *5*	902.7	7/2⁻	0	7/2⁺				A_2=+0.28 *6*; A_4=0.00 *8*
907.6	4.6 *5*	1841.7	13/2⁺	934.1	11/2$^{(+)}$	(M1+E2)	−0.44 *20*	5.78×10⁻⁴ *11*	A_2=−0.97 *10*; A_4=+0.08 *10* Mult.: D+Q from A_2, A_4.
926.6	100	976.3	13/2⁺	49.57	9/2⁺	Q			A_2=+0.449 *23*; A_4=−0.13 *3*
977.4	≤3.0	2420.2		1442.8	9/2⁻				
985.7	≤2.5	1442.8	9/2⁻	456.7	5/2⁻				
1017.2	8.4 *4*	1993.6	15/2⁺	976.3	13/2⁺	D+Q	−0.94 *+10−20*		A_2=−0.93 *4*; A_4=+0.10 *3*
1120.3	7.4 *3*	1993.6	15/2⁺	873.5	11/2⁺	Q			A_2=+0.36 *3*; A_4=−0.14 *4*
1135.0	≤0.5	2069.1		934.1	11/2$^{(+)}$				
1159.3	15.3 *7*	2135.6	17/2⁺	976.3	13/2⁺	Q			A_2=+0.31 *5*; A_4=−0.12 *6*
1232.1	3.6 *3*	2166.1	13/2⁻	934.1	11/2$^{(+)}$	(E1)		2.11×10⁻⁴	A_2=−0.24 *3*; A_4=−0.05 *4* Mult.: D from A_2, A_4; systematics favor E1.
1257.3	7.3 *4*	2191.4	(15/2⁺)	934.1	11/2$^{(+)}$	(E2)		3.15×10⁻⁴	A_2=+0.42 *4*; A_4=−0.13 *6* Doublet if Eα>16.5 MeV. Mult.: Q from A_2, A_4; systematics favor E2.
1292.6	3.2 *3*	2166.1	13/2⁻	873.5	11/2⁺	(E1)		2.40×10⁻⁴	A_2=−0.10 *4*; A_4=−0.12 *5* Mult.: D from A_2, A_4; systematics favor E1.
1343.5	2.8 *3*	2217.0	(13/2⁺)	873.5	11/2⁺	(M1+E2)	−1.8 *+5−8*	2.93×10⁻⁴	A_2=−0.72 *7*; A_4=+0.19 *6* Mult.: D+Q from A_2, A_4.
1349.3 [&]	4.6 *3*	1348.8	9/2⁻	0	7/2⁺	(E1)		2.68×10⁻⁴	A_2=−0.13 *7*; A_4=−0.04 *9* Mult.: D from A_2, A_4; systematics favor E1.
1428.9	≤3.0	2363.0		934.1	11/2$^{(+)}$				
1557.4	9.3 *4*	2533.6	(15/2)	976.3	13/2⁺				A_2=−0.08 *2*; A_4=−0.08 *3*

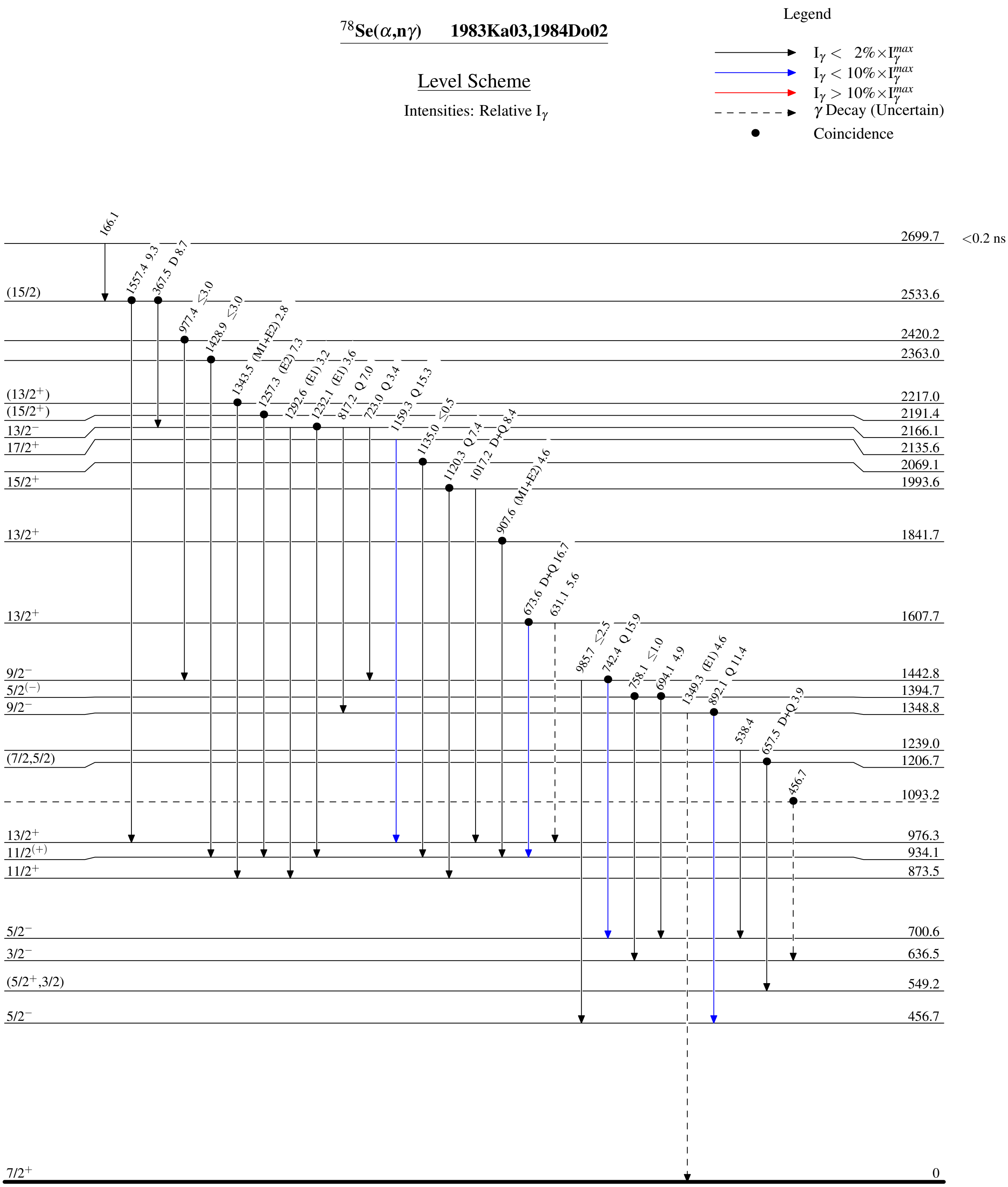
† From 1983Ka03. Iγ relative to I(927γ)=100; ΔE not given by authors.

‡ From Adopted Gammas.

From γ(θ) (1983Ka03).

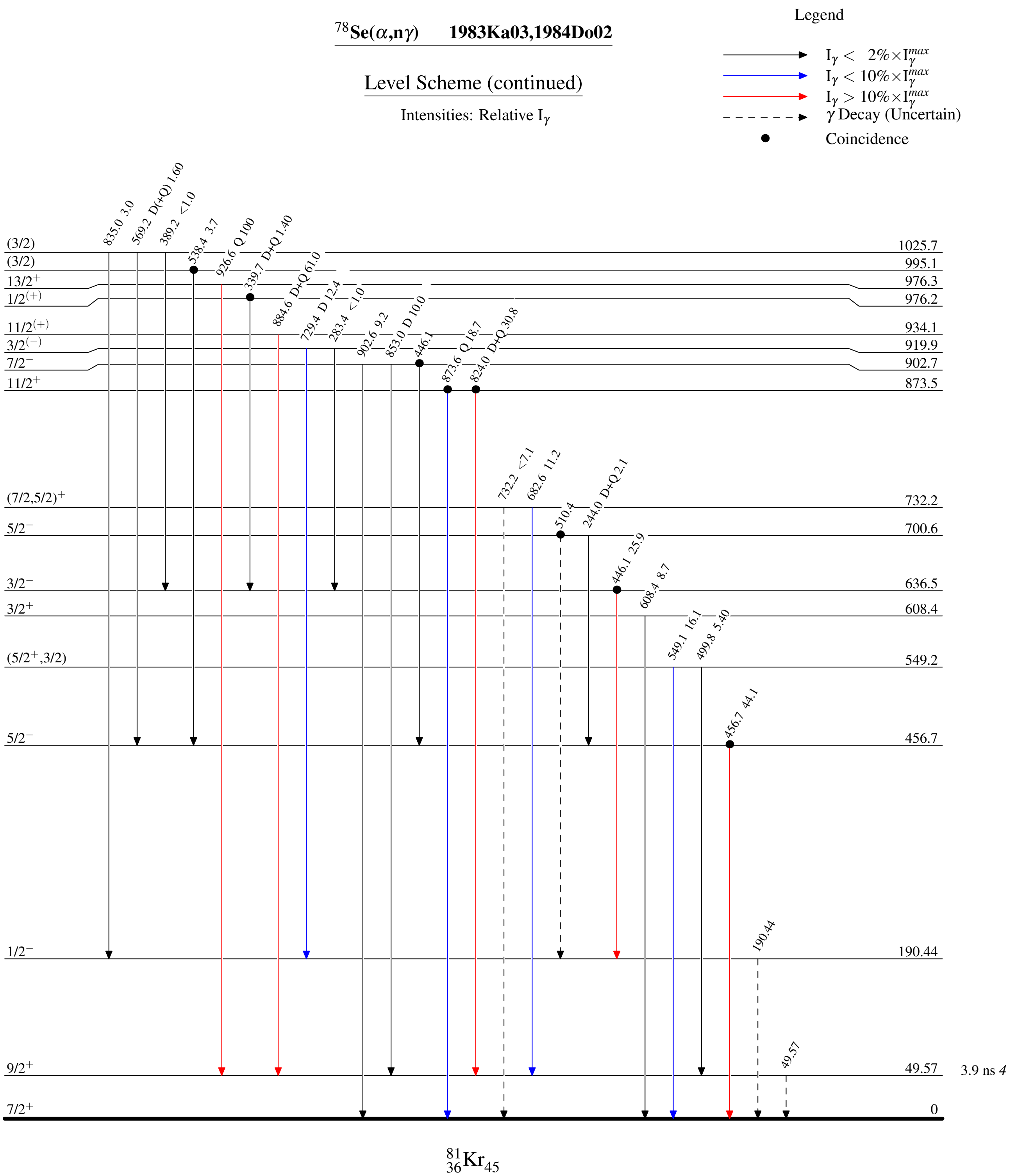
@ Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

& Placement of transition in the level scheme is uncertain.



78Se(α,nγ) 1983Ka03,1984Do02
Level Scheme
Intensities: Relative Iγ
Legend
Iγ < 2%×Iγmax
Iγ < 10%×Iγmax
Iγ > 10%×Iγmax
γ Decay (Uncertain)
Coincidence
2699.7 <0.2 ns
(15/2) 2533.6
2420.2
2363.0
(13/2+) 2217.0
(15/2+) 2191.4
13/2− 2166.1
17/2+ 2135.6
2069.1
15/2+ 1993.6
13/2+ 1841.7
13/2+ 1607.7
9/2− 1442.8
5/2(−) 1394.7
9/2− 1348.8
1239.0
(7/2,5/2) 1206.7
1093.2
13/2+ 976.3
11/2(+) 934.1
11/2+ 873.5
5/2− 700.6
3/2− 636.5
(5/2+,3/2) 549.2
5/2− 456.7
7/2+ 0
166.1
1557.4 9.3
367.5 D 8.7
977.4 ≤3.0
1428.9 ≤3.0
1343.5 (M1+E2) 2.8
1257.3 (E2) 7.3
1292.6 (E1) 3.2
1232.1 (E1) 3.6
817.2 Q 7.0
723.0 Q 3.4
1159.3 Q 15.3
1135.0 ≤0.5
1120.3 Q 7.4
1017.2 D+Q 8.4
907.6 (M1+E2) 4.6
673.6 D+Q 16.7
631.1 5.6
985.7 ≤2.5
742.4 Q 15.9
758.1 ≤1.0
694.1 4.9
1349.3 (E1) 4.6
892.1 Q 11.4
538.4
657.5 D+Q 3.9
456.7

$^{81}_{36}Kr_{45}$


^{78}Se(α,nγ) 1983Ka03,1984Do02
Level Scheme (continued)
Intensities: Relative Iγ
Legend
Iγ < 2%×Iγ max
Iγ < 10%×Iγ max
Iγ > 10%×Iγ max
γ Decay (Uncertain)
Coincidence
(3/2) 1025.7
(3/2) 995.1
13/2+ 976.3
1/2(+) 976.2
11/2(+) 934.1
3/2(−) 919.9
7/2− 902.7
11/2+ 873.5
(7/2,5/2)+ 732.2
5/2− 700.6
3/2− 636.5
3/2+ 608.4
(5/2+,3/2) 549.2
5/2− 456.7
1/2− 190.44
9/2+ 49.57 3.9 ns 4
7/2+ 0
835.0 3.0
569.2 D(+Q) 1.60
389.2 <1.0
538.4 3.7
926.6 Q 100
339.7 D+Q 1.40
884.6 D+Q 61.0
729.4 D 12.4
283.4 <1.0
902.6 9.2
853.0 D 10.0
446.1
873.6 Q 18.7
824.0 D+Q 30.8
732.2 <7.1
682.6 11.2
510.4
244.0 D+Q 2.1
446.1 25.9
608.4 8.7
549.1 16.1
499.8 5.40
456.7 44.1
190.44
49.57
$^{81}_{36}Kr_{45}$