^{80}Se(^{11}B,4nγ) 1998Sc22

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	T. D. Johnson and W. D. Kulp(a)	NDS 129, 1 (2015)	27-Jul-2015

E=45 MeV. Measured Eγ, Iγ, $\gamma\gamma$, $\gamma\gamma(\theta)$(DCO) and lifetimes using OSIRIS CUBE detector array with six detectors.

^{87}Y Levels

E(level)	J$^{\pi}$[†]	T$_{1/2}$[‡]	Comments
0.0[#]	1/2$^-$		
380.81[&] *10*	9/2$^+$		
793.5[#] *3*	5/2$^-$		
1404.41[&] *14*	13/2$^+$		
1590.71 *14*	11/2$^+$		
1629.3 *6*			J$^{\pi}$: assigned (1/2$^-$,3/2$^-$) in Adopted Levels.
1768.0[#] *6*	(9/2$^-$)		
2008.4 *6*			J$^{\pi}$: assigned (7/2) in Adopted Levels.
2037.7 *4*	(11/2$^+$)		J$^{\pi}$: from Adopted Levels. Assigned (11/2$^-$) in 1998Sc22, although no DCO ratios were obtained for populating or depopulating transitions, and the authors do not discuss on what experimental basis this assignment was made.
2366.72 *17*	15/2$^-$		
2428.02[&] *17*	(17/2$^+$)		J$^{\pi}$: Band placement.
2478.9[@] *3*	(13/2)$^-$		J$^{\pi}$: from Adopted Levels.
2648.8[@] *3*	(15/2$^-$)		
2675.82 *19*	17/2$^-$		J$^{\pi}$: Consistent with definitive assignment in Adopted Levels from additional strong arguments.
2808.2[#] *8*	(13/2$^-$)		
2827.02[&] *20*	(21/2$^+$)		
2961.2[@] *3*	17/2$^-$		J$^{\pi}$: Agrees with Adopted Levels which has additional strong arguments.
2986.8 *3*	(19/2$^+$)		
3402.2[@] *3*	(19/2$^-$)		
3446.3 *3*	(19/2$^-$)		
3552.77[&] *21*	(23/2$^+$)	0.083 ps *21*	J$^{\pi}$: From R(DCO) and band placement.
3766.4[@] *4*	(21/2$^-$)		
3908.6 *4*	(23/2$^-$)		
4039.23[&] *22*	(25/2$^+$)	0.17 ps *4*	J$^{\pi}$: band placement.
4554.9 *4*	(23/2$^+$)		
4563.9 *3*	(23/2$^-$)		
4609.49 *21*	25/2$^+$	0.12 ps *4*	J$^{\pi}$: From stretched Q (assumed to be E2) to 21/2$^+$.
5228.0 *3*	(25/2$^-$)		
5288.30[&] *23*	(27/2$^+$)	0.10 ps *3*	
5319.5 *4*	(25/2$^-$)		
5495.1 *4*	(25/2$^+$)		
5759.4[a] *3*	(27/2$^-$)	>2.1 ps	
5826.9 *3*	(27/2$^+$)		J$^{\pi}$: Originally assigned 27/2$^{(+)}$ in 1998Sc22. However as the authors note, the B(E1) strength for the 108 transition feeding the level from the 5935 state with (29/2$^-$) exceeds RUL. No other experimental information is sufficient to adopt a definite value for parity.
5934.3[a] *3*	(29/2$^-$)	1.8 ps *4*	J$^{\pi}$: As the authors note, if a positive parity, this would result in excessively large B(M2)(W.u.) values for the ΔJ=2 *615* and 706 transitions.
6535.3[a] *3*	(31/2$^-$)	0.18 ps *4*	J$^{\pi}$: Supported by DCO and shell model calculations. See 1998Sc22.
7016.4[a] *3*	(33/2$^-$)	0.11 ps *3*	J$^{\pi}$: Supported by DCO and shell model calcuations. See 1998Sc22.

Continued on next page (footnotes at end of table)

^{80}Se(^{11}B,4nγ) 1998Sc22 (continued)

^{87}Y Levels (continued)

† Based on multiple order of γ transitions deduced from directional correlations of de-exciting oriented states (DCO) ratios; Additonal supporting are noted along with any differences from assignments in Adopted Levels.
‡ From DSAM.
# Band(A): $1/2^-$ decoupled ground-state band.
@ Band(B): $\Delta J=1$ band based on $13/2^-$.
& Band(C): Yrast states, positive parity.
a Band(D): Other positive parity yrast states.

^{80}Se(^{11}B,4nγ) 1998Sc22 (continued)

$\gamma(^{87}Y)$

DCO ratios are for gating on ΔJ=2 transitions, unless otherwise stated.

E_γ[†]	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ	α[a]	Comments
27.0 *5*		2675.82	17/2$^-$	2648.8	(15/2$^-$)				
107.5 *5*	4.0[@] *4*	5934.3	(29/2$^-$)	5826.9	(27/2$^+$)	(D)			DCO=0.24 6. Mult.: DCO suggests mult=dipole and placement in the level scheme requires Δπ=yes; however, this leads to B(E1)(W.u.)=0.02, which exceeds the RUL of 0.01. This was noted in 1998Sc22.
142.2 *5*	0.7[@] *2*	3908.6	(23/2$^-$)	3766.4	(21/2$^-$)	(D,Q)			DCO=0.68 26.
159.8 *3*	6.0 *3*	2986.8	(19/2$^+$)	2827.02	(21/2$^+$)	(M1+E2)	+0.25 *15*	0.059 *12*	α(K)=0.052 *10*; α(L)=0.0061 *15*; α(M)=0.00105 *25* α(N)=0.00014 *3*; α(O)=9.1×10^{-6} *15* Mult.: $T_{1/2}$ in Adopted Levels for 2986 is used so that RUL can rule out E1+M2. DCO=0.59 3.
169.9 *1*	13.3[@] *6*	2648.8	(15/2$^-$)	2478.9	(13/2)$^-$	D(+Q)	−0.15 *25*		DCO=0.59 6.
174.9 *1*	10.4[@] *6*	5934.3	(29/2$^-$)	5759.4	(27/2$^-$)	D+Q	−0.20 *12*		DCO=0.59 3, 0.92 7 (ΔJ=1 gated).
247.9 *5*	3.4[@] *3*	2675.82	17/2$^-$	2428.02	(17/2$^+$)	(E1+M2)	+0.19 *11*	0.010 *4*	α(K)=0.009 *3*; α(L)=0.0010 *4*; α(M)=0.00018 *7* α(N)=2.4×10^{-5} *9*; α(O)=1.6×10^{-6} *6* DCO=0.97 5. Mult.: R(DCO) gives mult=Q and RUL eliminates E1+M2.
264.3 *5*	0.7[@] *1*	5759.4	(27/2$^-$)	5495.1	(25/2$^+$)	(D)			α(K)=0.00571 *9*; α(L)=0.000627 *10*; α(M)=0.0001066 *16* α(N)=1.423×10^{-5} *22*; α(O)=9.59×10^{-7} *15* DCO=0.64 7. δ: −0.20 *20*. Mult.: Although a calculated mixing ratio of −0.20 *20* for M2/E1 is reported, an M2 component is excluded by RUL for larger half-lives reasonably close to 2.1 ps.
285.4 *3*	5.5 *3*	2961.2	17/2$^-$	2675.82	17/2$^-$	(M1+E2)	+0.07 *28*	0.0114 *14*	α(K)=0.0100 *12*; α(L)=0.00112 *16*; α(M)=0.00019 *3* α(N)=2.6×10^{-5} *4*; α(O)=1.79×10^{-6} *19* Mult.: D+Q from R(DCO) and then γ to 17/2$^-$ gives (M1+E2). DCO=0.96 7, 1.42 12 (ΔJ=1 gated).
309.1 *1*	17[@] *2*	2675.82	17/2$^-$	2366.72	15/2$^-$	(M1+E2)	−0.08 *8*	0.00932 *22*	α(K)=0.00822 *19*; α(L)=0.000920 *24*; α(M)=0.000157 *4* α(N)=2.11×10^{-5} *6*; α(O)=1.47×10^{-6} *3* DCO=0.62 2, 0.90 3 (ΔJ=1 gated). Mult.: D+Q from R(DCO). If the adopted δ of +0.20 *4* is used E1+M2 is eliminated from RUL.
312.3 *5*	2.2[@] *2*	2961.2	17/2$^-$	2648.8	(15/2$^-$)	(D+Q)	−0.4 *3*		DCO=0.52 8.
331.7 *5*	0.4[@] *1*	5826.9	(27/2$^+$)	5495.1	(25/2$^+$)				

$^{87}_{39}Y_{48}$-3

^{80}Se(^{11}B,4nγ) 1998Sc22 (continued)

$\gamma(^{87}Y)$ (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ	α[a]	Comments
364.1 *5*	3.9 *3*	3766.4	(21/2$^-$)	3402.2	(19/2$^-$)	D(+Q)	−0.15 *20*		DCO=0.61 6.
380.8 *1*	234 *10*	380.81	9/2$^+$	0.0	1/2$^-$	M4		0.256	α(K)=0.217 *3*; α(L)=0.0329 *5*; α(M)=0.00575 *8* α(N)=0.000753 *11*; α(O)=4.46×10^{-5} *7* Mult.: From Adopted Levels.
399.0 *1*	100 *2*	2827.02	(21/2$^+$)	2428.02	(17/2$^+$)	E2		0.00793	α(K)=0.00695 *10*; α(L)=0.000817 *12*; α(M)=0.0001396 *20* α(N)=1.85×10^{-5} *3*; α(O)=1.177×10^{-6} *17* DCO=1.01 2. Mult.: Stretched Q from DCO, assumed by evaluators to be E2.
439.7 *5*	0.8[@] *2*	5759.4	(27/2$^-$)	5319.5	(25/2$^-$)	D(+Q)	+0.10 *10*		DCO=0.73 4 Corresponds to the 439.7+440.9+441.1 apparently unresolved triplet, 1988Sc22.
440.9 *5*	3.8[@] *3*	3402.2	(19/2$^-$)	2961.2	17/2$^-$	(D,Q)			Mult.: Given as only (M1) in 1998Sc22.
441.1 *5*	3.0[@] *3*	2478.9	(13/2)$^-$	2037.7	(11/2$^+$)	[E1]		0.00177 *13*	α(K)=0.00156 *11*; α(L)=0.000171 *13*; α(M)=2.92×10^{-5} *22* α(N)=3.9×10^{-6} *3*; α(O)=2.69×10^{-7} *20*
481.1 *1*	14[@&] *2*	7016.4	(33/2$^-$)	6535.3	(31/2$^-$)	(D+Q)	−0.10 *15*		DCO=0.65 10.
486.4 *1*	41[@&] *3*	4039.23	(25/2$^+$)	3552.77	(23/2$^+$)	D(+Q)	−0.16 *20*	0.00312 *12*	α(K)=0.00276 *10*; α(L)=0.000305 *13*; α(M)=5.21×10^{-5} *22* α(N)=7.0×10^{-6} *3*; α(O)=4.89×10^{-7} *16* DCO=0.60 6.
506.4 *5*	3.3[@] *2*	3908.6	(23/2$^-$)	3402.2	(19/2$^-$)	[Q]			
531.5 *5*	0.5[@] *2*	5759.4	(27/2$^-$)	5228.0	(25/2$^-$)				
558.7 *5*	2.1[@] *2*	2986.8	(19/2$^+$)	2428.02	(17/2$^+$)	[M1,E2]			
569.0 *5*	1.3[@] *3*	4609.49	25/2$^+$	4039.23	(25/2$^+$)				
601.0 *1*	29[@&] *2*	6535.3	(31/2$^-$)	5934.3	(29/2$^-$)	(D+Q)	+0.14 *14*		DCO=0.76 6.
615.0 *5*	2.2[@] *4*	5934.3	(29/2$^-$)	5319.5	(25/2$^-$)				
633.3 *5*	4.7[@] *5*	2037.7	(11/2$^+$)	1404.41	13/2$^+$				
646.0 *3*	8.3[@] *6*	5934.3	(29/2$^-$)	5288.30	(27/2$^+$)	D+Q	−0.5 *4*		DCO=0.53 6.
678.8 *1*	11[@&] *2*	5288.30	(27/2$^+$)	4609.49	25/2$^+$	(D,Q)			DCO=0.32 2. The DCO ratio was smaller than the theoretical results and so no mixing ratio was derived (1998Sc22).
706.3 *5*	4.6 *5*	5934.3	(29/2$^-$)	5228.0	(25/2$^-$)				
725.8 *1*	59[@&] *5*	3552.77	(23/2$^+$)	2827.02	(21/2$^+$)	D(+Q)	−0.20 *22*		DCO=0.59 6.
726.4 *3*	7.5 *6*	3402.2	(19/2$^-$)	2675.82	17/2$^-$	D(+Q)	+0.09 *11*		DCO=0.70 5 (ΔJ=1 gated).
770.5 *3*	6.2 *7*	3446.3	(19/2$^-$)	2675.82	17/2$^-$	(D+Q)	−0.19 *17*		DCO=0.58 5.
793.5 *3*	6.6 *4*	793.5	5/2$^-$	0.0	1/2$^-$				
835.8 *5*	1.0[@] *1*	1629.3		793.5	5/2$^-$				
888.2 *1*	11.7 *6*	2478.9	(13/2)$^-$	1590.71	11/2$^+$	(D)			
940.1 *5*	0.9[@] *1*	5495.1	(25/2$^+$)	4554.9	(23/2$^+$)	D+Q	−0.8 *5*		DCO=0.52 6.
962.3 *1*	18.2 *9*	2366.72	15/2$^-$	1404.41	13/2$^+$	D			δ: δ(Q/D)=+0.03 *7*. DCO=0.65 2.
974.5 *5*	0.7 *1*	1768.0	(9/2$^-$)	793.5	5/2$^-$				

$^{87}_{39}Y_{48}$-4

^{80}Se(^{11}B,4nγ) 1998Sc22 (continued)

$\gamma(^{87}Y)$ (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ	α[a]	Comments
1011.4 *5*	2.4 *10*	4563.9	(23/2$^-$)	3552.77	(23/2$^+$)	(D)			DCO=0.9 5.
1023.6 *1*	159 *19*	1404.41	13/2$^+$	380.81	9/2$^+$				DCO=1.01 4 (combined value from a doublet). I_γ: From the value of the 1024 peak with the component from the 1024 γ transition from the 2428 level subtracted out.
1023.6 *1*	129[@] *7*	2428.02	(17/2$^+$)	1404.41	13/2$^+$	[E2]		5.91×10^{-4}	α(K)=0.000522 *8*; α(L)=5.74×10^{-5} *8*; α(M)=9.80×10^{-6} *14* α(N)=1.316×10^{-6} *19*; α(O)=9.10×10^{-8} *13* DCO=1.01 *4* Combined value from doublet.
1040.2 *5*	0.3[@] *1*	2808.2	(13/2$^-$)	1768.0	(9/2$^-$)				
1056.8 *1*	12[@&] *3*	4609.49	25/2$^+$	3552.77	(23/2$^+$)	D(+Q)	0.04 *18*		DCO=0.70 8.
1090.6 *5*	2.6[@] *3*	3766.4	(21/2$^-$)	2675.82	17/2$^-$	(E2)		5.12×10^{-4}	α(K)=0.000453 *7*; α(L)=4.96×10^{-5} *7*; α(M)=8.47×10^{-6} *12* α(N)=1.138×10^{-6} *16*; α(O)=7.89×10^{-8} *11* DCO=1.49 20 (ΔJ=1 gated).
1117.6 *3*	5.9 *4*	4563.9	(23/2$^-$)	3446.3	(19/2$^-$)	E2		4.86×10^{-4}	α(K)=0.000429 *6*; α(L)=4.70×10^{-5} *7*; α(M)=8.01×10^{-6} *12* α(N)=1.077×10^{-6} *15*; α(O)=7.47×10^{-8} *11*; α(IPF)=1.145×10^{-6} *19* DCO=1.02 7, 1.40 10 (ΔJ=1 gated). Mult.: Evaluators assume Q most likely E2.
1161.7 *5*	1.8 *2*	4563.9	(23/2$^-$)	3402.2	(19/2$^-$)				
1189.1 *5*	1.4 *2*	5228.0	(25/2$^-$)	4039.23	(25/2$^+$)	(D)			α(K)=0.0001723 *25*; α(L)=1.85×10^{-5} *3*; α(M)=3.15×10^{-6} *5* α(N)=4.25×10^{-7} *6*; α(O)=2.99×10^{-8} *5*; α(IPF)=3.67×10^{-5} *6* DCO=0.87 18.
1195.6 *3*	5.7[@] *4*	5759.4	(27/2$^-$)	4563.9	(23/2$^-$)	(E2)		4.26×10^{-4}	α(K)=0.000370 *6*; α(L)=4.04×10^{-5} *6*; α(M)=6.90×10^{-6} *10* α(N)=9.27×10^{-7} *13*; α(O)=6.45×10^{-8} *9*; α(IPF)=7.38×10^{-6} *11* DCO=1.45 13 (ΔJ=1 gated). Mult.: Supports the tentative π=− assignment, as π=+ results in an M2 of over 130 W.u., excluded by RUL.
1209.9 *1*	26.6 *12*	1590.71	11/2$^+$	380.81	9/2$^+$				
1214.9 *5*	0.9[@] *1*	2008.4		793.5	5/2$^-$				
1217.4 *3*	5.9[@] *8*	5826.9	(27/2$^+$)	4609.49	25/2$^+$	(M1+E2)	−1.0 *3*		DCO=0.45 4.
1249.0 *5*	1.3[@] *2*	5288.30	(27/2$^+$)	4039.23	(25/2$^+$)	(D,Q)			DCO=0.21 4. The DCO ratio was smaller then theoretical results and so no mixing ratio was derived (1998Sc22).
1319.4 *5*	1.8[@] *2*	5228.0	(25/2$^-$)	3908.6	(23/2$^-$)	D(+Q)	0.14 *22*		DCO=0.75 11, 1.17 16 (ΔJ=1 gated).
1553.0 *5*	3.5[@&] *5*	5319.5	(25/2$^-$)	3766.4	(21/2$^-$)	(E2)		3.48×10^{-4}	α(K)=0.000216 *3*; α(L)=2.34×10^{-5} *4*; α(M)=3.99×10^{-6} *6* α(N)=5.37×10^{-7} *8*; α(O)=3.77×10^{-8} *6*; α(IPF)=0.0001047 *15* DCO=1.37 15 (ΔJ=1 gated).
1568.2 *5*	2.1 *3*	4554.9	(23/2$^+$)	2986.8	(19/2$^+$)	(E2)		3.50×10^{-4}	α(K)=0.000212 *3*; α(L)=2.29×10^{-5} *4*; α(M)=3.91×10^{-6} *6* α(N)=5.27×10^{-7} *8*; α(O)=3.70×10^{-8} *6*; α(IPF)=0.0001110 *16* DCO=1.99 23.
1656.8 *5*	2.3 *2*	2037.7	(11/2$^+$)	380.81	9/2$^+$				
1675.1 *5*	1.0 *1*	5228.0	(25/2$^-$)	3552.77	(23/2$^+$)	(D+Q)	−0.27 *27*		DCO=0.56 9.

$^{87}_{39}Y_{48}$-5

^{80}Se(^{11}B,4nγ) 1998Sc22 (continued)

$\gamma(^{87}Y)$ (continued)

E_γ [†]	I_γ [‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [#]	δ	α [a]	Comments
1720.0 *3*	5.4 *6*	5759.4	(27/2$^-$)	4039.23	(25/2$^+$)	(E1+M2)	−0.14 *10*	5.20×10^{-4}	α(K)=9.7×10^{-5} *10*; α(L)=1.04×10^{-5} *11*; α(M)=1.78×10^{-6} *18* α(N)=2.39×10^{-7} *24*; α(O)=1.69×10^{-8} *17*; α(IPF)=0.000411 *14* DCO=0.61 3. Mult.: (D+Q) from DCO and additional support from level scheme placement.
1727.6 *5*	1.3 *4*	4554.9	(23/2$^+$)	2827.02	(21/2$^+$)				
1735.8 *5*	2.3[@] *3*	5288.30	(27/2$^+$)	3552.77	(23/2$^+$)				
1782.4 *1*	10[@&] *2*	4609.49	25/2$^+$	2827.02	(21/2$^+$)	E2		3.91×10^{-4}	α(K)=0.0001654 *24*; α(L)=1.785×10^{-5} *25*; α(M)=3.04×10^{-6} *5* α(N)=4.10×10^{-7} *6*; α(O)=2.89×10^{-8} *4*; α(IPF)=0.000204 *3* DCO=1.03 13.
1787.8 *5*	2.6 *4*	5826.9	(27/2$^+$)	4039.23	(25/2$^+$)				
1942.2 *5*	1.1 *1*	5495.1	(25/2$^+$)	3552.77	(23/2$^+$)	D+Q	−0.8 *3*		DCO=0.43 6.

[†] Authors state that $\Delta(E\gamma)$=0.1 to 0.5 keV. Evaluators assign 0.1 keV for Iγ>10%, 0.3 keV for Iγ=5-10% and 0.5 keV for Iγ<5%.
[‡] These relative values represent A_0 in $\gamma(\theta)$ distributions, deduced from singles spectra at θ=45° and 90°.
[#] DCO values given are the ratios W(90°,45°,90°)/W(45°,90°,90°).
[@] From $\gamma\gamma$ coincidence spectra.
[&] Corrected for Doppler-shifted portion of the intensity.
[a] Additional information 1.

$^{87}_{39}Y_{48}$-6

^{80}Se(^{11}B,4nγ) 1998Sc22

Level Scheme

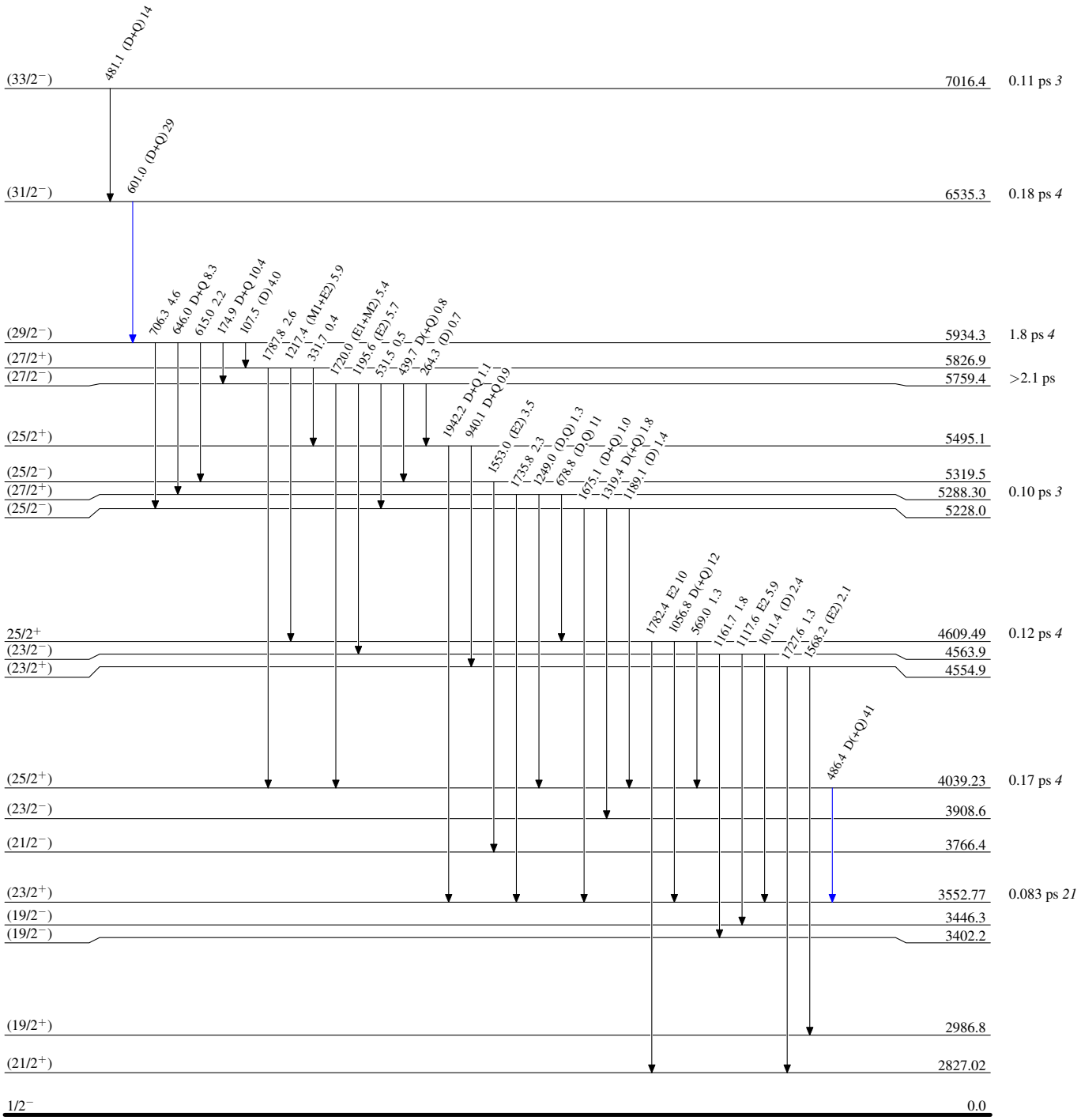
Intensities: Relative I_γ

Legend

$I_\gamma < 2\% \times I_\gamma^{max}$

$I_\gamma < 10\% \times I_\gamma^{max}$

$I_\gamma > 10\% \times I_\gamma^{max}$



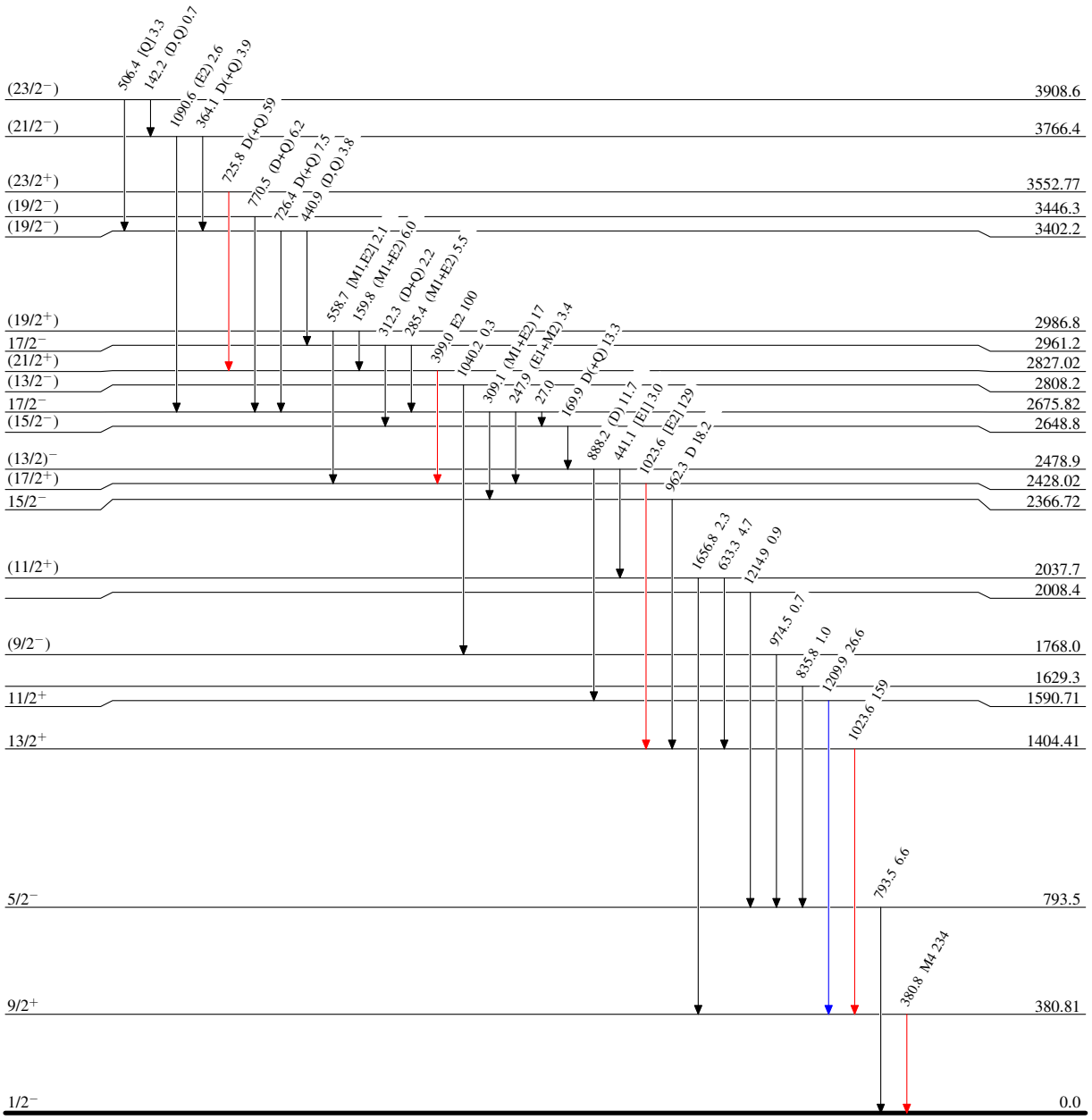
$^{87}_{39}Y_{48}$

^{80}Se(^{11}B,4nγ) 1998Sc22

Level Scheme (continued)

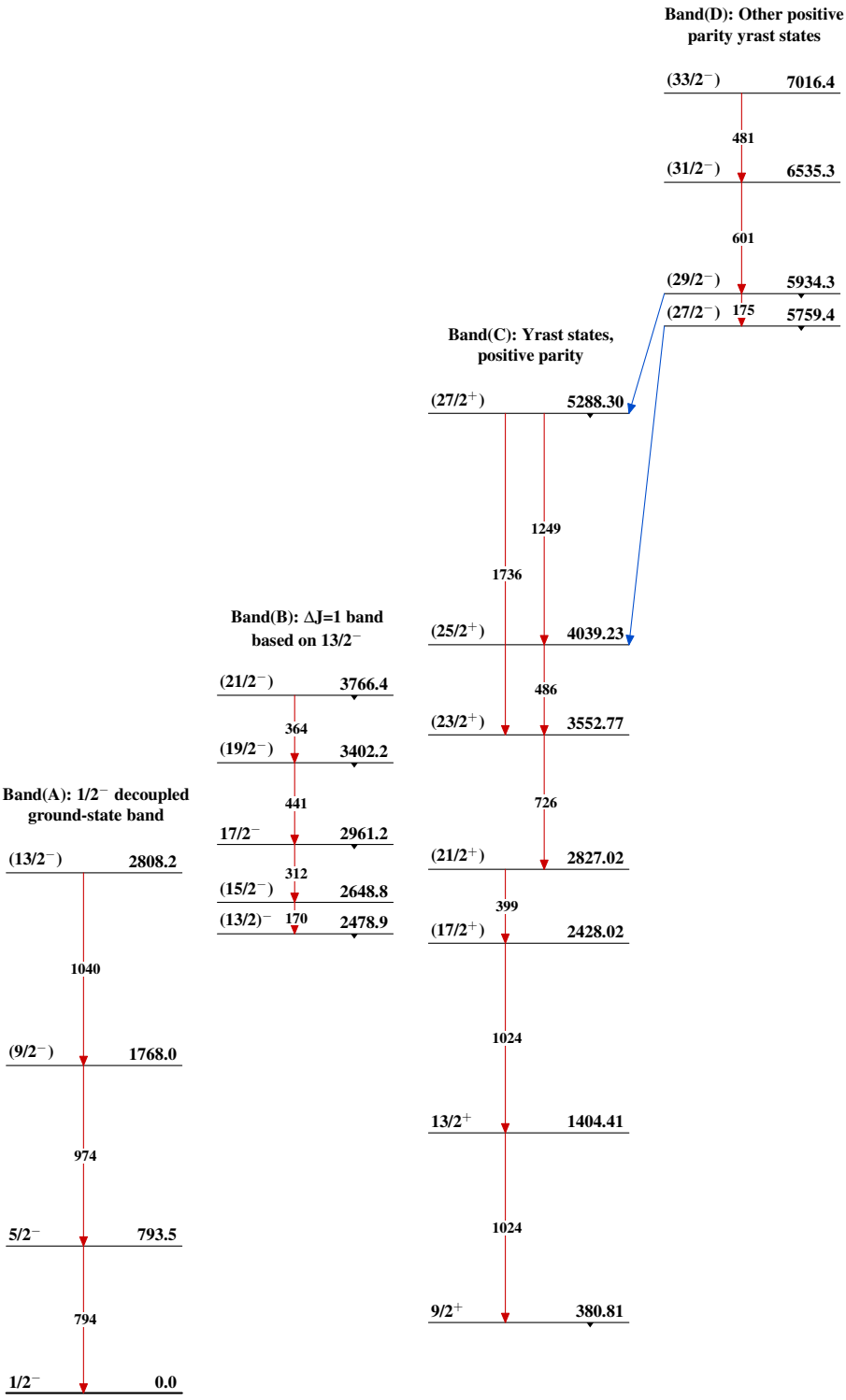
Intensities: Relative I_γ

Legend
$I_\gamma < 2\% \times I_\gamma^{max}$
$I_\gamma < 10\% \times I_\gamma^{max}$
$I_\gamma > 10\% \times I_\gamma^{max}$



$^{87}_{39}Y_{48}$

^{80}Se(^{11}B,4nγ) 1998Sc22



$^{87}_{39}Y_{48}$