^{78}Se(α,p2nγ),^{77}Se(α,npγ) 1988Sc13

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	NDS 135, 193 (2016)	31-May-2016

^{78}Se(α,p2nγ) E=45 MeV and ^{77}Se(α,npγ) E=27 MeV. Measured γ, γγ, pγ, γ(θ), γ(lin pol), $T_{1/2}$ by DSAM and RDDS methods.
Others:
See also ^{78}Se(d,nγ) (1989DjZW) and ^{76}Ge(^{6}Li,3nγ) (1988NaZP).
1974GoYY: ^{77}Se(α,npγ). Measured γ, γγ, γγ(θ), $T_{1/2}$ by DSA method.
A_2: A_4 and γ(lin pol) coefficients are from ^{78}Se(α,p2nγ), unless stated otherwise.

^{79}Br Levels

The placements of all transitions in the level scheme are from γγ data.

E(level)[†]	Jπ[‡]	$T_{1/2}$[#]	Comments
0.0[&]	3/2−		
207.5[@] 1	9/2+	4.85 s 4	%IT=100 $T_{1/2}$: from Adopted Levels.
217.1[&] 1	5/2−	51 ps 12	$T_{1/2}$: RDDS method in (α,pnγ) (γγ coin).
261.4 1	3/2−		
397.79 14	1/2−,3/2−		Population of this level here is uncertain since 397γ (about 10 times as intense as 136γ (see Adopted Gammas)) has not been reported by 1988Sc13. However, in a spectrum shown by 1988Sc13 there is some evidence of a 397 γ-ray line which has been assigned to an impurity by 1988Sc13.
761.35[&] 11	7/2−		
796.80[@] 14	13/2+	9.0 ps 21	$T_{1/2}$: RDDS method in (α,pnγ); weighted average of values from singles γ data at two distances.
954.06 16	(7/2−)		
1068.0[&] 2	9/2−		
1114 1	1/2−,3/2−		
1180.7 2	11/2+	0.55 ps 14	$T_{1/2}$: DSA method in (α,pnγ) (pγ coin).
1332? 1	3/2−		Population of this level in this reaction is uncertain since 1115γ or 1333γ (intense γ rays from this level in Adopted Gammas) is not seen.
1333.0 2	(5/2,7/2,9/2)		
1682.8 2	13/2+		
1713.4[&] 2	11/2−	0.42 ps +35−14	$T_{1/2}$: DSA in (α,pnγ).
1731.9[@] 3	17/2+	1.18 ps 21	$T_{1/2}$: DSA in (α,pnγ) and (α,p2nγ); weighted average of four separate values from singles γ and pγ coin data.
1948.0[&] 3	13/2−		
1957.1 3	15/2+		
2393.1 2	13/2−	3.5 ps 21	$T_{1/2}$: DSA in (α,pnγ) and (α,p2nγ); weighted average of values from singles γ and pγ coin data. Feeding correction is not applied.
2421.4 3	17/2+		
2468.8 4			
2479.0[a] 3	(13/2−)		Bandhead at 2393 (Jπ=13/2−) is also possible but 2479 is preferred (see discussion by 1988Sc13).
2580.4[a] 2	15/2−		
2725.2[&] 3	17/2−		
2773.9[a] 3	17/2−	8 ps 3	$T_{1/2}$: RDDS in (α,pnγ); weighted average of values from γγ coin.
2865.9[@] 4	21/2+	0.42 ps 14	$T_{1/2}$: DSA in (α,pnγ) and (α,p2nγ); weighted average of four separate values from singles γ and pγ coin data.
2902.9 4			

Continued on next page (footnotes at end of table)

^{78}Se(α,p2nγ),^{77}Se(α,npγ) 1988Sc13 (continued)

^{79}Br Levels (continued)

E(level)[†]	Jπ[‡]	$T_{1/2}$[#]	Comments
3088.3[a] 3	(19/2)$^-$	1.0 ps 5	$T_{1/2}$: DSA in (α,pnγ).
3366.3 5			
3535.7[a] 4	(21/2)$^-$	0.76 ps 14	$T_{1/2}$: DSA in (α,pnγ) and (α,p2nγ); weighted average of values from singles γ and pγ coin data.
3560.3 5			
3936.4 8			
4116.9[@] 8	25/2$^+$	0.28 ps 14	$T_{1/2}$: DSA in (α,pnγ) and (α,p2nγ); weighted average of values from singles γ and pγ coin data.

[†] From least-squares fit to Eγ values.

[‡] From γ(θ), γ(lin pol) and band assignments. See Adopted Levels for details.

[#] From DSA method, unless otherwise stated.

[@] Band(A): $\pi g_{9/2}$+^{78}Se core.

[&] Band(B): $\pi p_{3/2}$.

[a] Band(C): $\pi g_{9/2}$+ν(+ parity)+ν (- parity).

γ(^{79}Br)

Relative intensities in ^{78}Se(α,pnγ) E=27 MeV
(from A0 term in γ(θ) data (1988Sc13))

Eγ	Iγ	Eγ	Iγ	Eγ	Iγ
101.4	1.6 1	544.2	21 1(@)		
136.4	9.4 6	571.6	8.1 5(@)	935.1	42 2
187.3	4.1 3	589.3	100 5	944.9	5 1(#)
193.5	13.3 7	632.4	2.3 2	952.0	13 1
207.5	150 8	645.4	2.1 3	973.2	14 2
217.1	78 4(@)	692.7	7.5 8	1070.5	2.8 4
261.4	66 5(@)	736.9	4.0 4	1134.0	21 2
306.6	16 1(@)	738.5	2.5 3	1160.3	14 1
314.4	10.3 6	755.4	3.7 6(#)	1624.6	2.1 5
		761.4	6.8 5	1783.8	5.1 5
383.9	2.0 3(#)	777.2	5.9 5(#)		
445.0	3.5 2	825.7	3 1(#)		
447.4	5.5 4	851.0	22 2		
464.5	4.2 3	867	2.7 6(#)		
472.0	2.4 3(#)	880.0	23 3		
502.1	6.6 7				
531.0	4.0 5(#)				

(#) intensity at 90 ° (1988Sc13)
(@) includes contribution from ^{79}Kr ε decay

E_γ	I_γ[†]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	δ[‡]	α[a]	Comments
101.4 *1*	1.9 *1*	2580.4	15/2⁻	2479.0	(13/2⁻)	D(+Q)	−0.08 *8*		A_2=−0.37 *7*; A_4=−0.08 *9*
136.4 *1*	5.2 *2*	397.79	1/2⁻,3/2⁻	261.4	3/2⁻				A_2=−0.29 *5*; A_4=+0.01 *8*
187.3 *1*	4.5 *1*	2580.4	15/2⁻	2393.1	13/2⁻	D+Q	−0.07 *3*		A_2=−0.36 *4*; A_4=+0.03 *7*
193.5 *1*	17.6 *3*	2773.9	17/2⁻	2580.4	15/2⁻	M1+E2	−0.04 *1*	0.0198	A_2=−0.34 *1*; A_4=−0.03 *2* α(K)=0.0176 *3*; α(L)=0.00191 *3*; α(M)=0.000304 *5* α(N)=2.84×10^{-5} *4* pol=−0.22 *20*.
207.5 *1*	123 *2*	207.5	9/2⁺	0.0	3/2⁻	E3			A_2=0.0 *1*; A_4=+0.02 *2* Mult.: from Adopted Gammas.
217.1 *1*	60[#] *1*	217.1	5/2⁻	0.0	3/2⁻	D(+Q)	+0.03 *3*		A_2=−0.13 *3*; A_4=−0.01 *4*
261.4 *1*	31[#] *3*	261.4	3/2⁻	0.0	3/2⁻				A_2=−0.19 *16*; A_4=−0.3 *3*
306.6 *3*	9.4[#] *4*	1068.0	9/2⁻	761.35	7/2⁻				A_2=−0.18 *9*; A_4=−0.19 *10*
314.4 *1*	16.5 *3*	3088.3	(19/2)⁻	2773.9	17/2⁻	M1+E2	−0.09 *4*	0.00588 *11*	A_2=−0.42 *3*; A_4=−0.05 *5* α(K)=0.00522 *10*; α(L)=0.000561 *11*; α(M)=8.92×10^{-5} *17* α(N)=8.33×10^{-6} *16* POL=−0.32 *15*.

γ(^{79}Br) (continued)

E_γ	I_γ[†]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	δ[‡]	α[a]	Comments
363[b] *1*	≈2[&]	3088.3	(19/2)⁻	2725.2	17/2⁻				
383.9 *4*	≈2[@&]	1180.7	11/2⁺	796.80	13/2⁺				
397.54		397.79	1/2⁻,3/2⁻	0.0	3/2⁻				E_γ: taken from Adopted Gammas.
445.0 *2*	3.3 *3*	2393.1	13/2⁻	1948.0	13/2⁻				A_2=+0.14 *6*; A_4=+0.28 *15*
447.4 *2*	10.5 *2*	3535.7	(21/2)⁻	3088.3	(19/2)⁻	M1+E2	−0.09 *2*	0.00251	A_2=−0.42 2; A_4=+0.01 *5* α(K)=0.00223 *4*; α(L)=0.000238 *4*; α(M)=3.78×10^{-5} *6* α(N)=3.53×10^{-6} *5*
464.5 *5*	5.2 *3*	2421.4	17/2⁺	1957.1	15/2⁺	D(+Q)	+0.04 *4*		A_2=−0.18 *6*; A_4=+0.08 *11* A_2, A_4 from (α,pnγ).
472.0 *4*	≈2[@&]	3560.3		3088.3	(19/2)⁻				
502.1 *1*	7 *1*	1682.8	13/2⁺	1180.7	11/2⁺	D+Q	−0.35 *5*		A_2=−0.70 *3*; A_4=+0.11 *6* A_2, A_4 from (α,pnγ). Mult.: most likely M1+E2 since E1+M2 would require $T_{1/2}$(1683)>4.5 ns.
531.0 *3*	≈4[@&]	2479.0	(13/2⁻)	1948.0	13/2⁻				
544.2 *1*	16.3[#] *5*	761.35	7/2⁻	217.1	5/2⁻	M1+E2	+0.19 *6*	0.00161 *3*	A_2=−0.12 *6*; A_4=−0.04 *15* α(K)=0.00143 *3*; α(L)=0.000152 *3*; α(M)=2.42×10^{-5} *5* α(N)=2.26×10^{-6} *4* A_2, A_4 from (α,pnγ).
571.6 *2*	6.9[#] *2*	1333.0	(5/2,7/2,9/2)	761.35	7/2⁻				A_2=−0.18 *5*; A_4=+0.02 *8*
589.3 *1*	100 *2*	796.80	13/2⁺	207.5	9/2⁺	E2		0.00182	A_2=+0.30 *1*; A_4=−0.09 *3* α(K)=0.001615 *23*; α(L)=0.0001748 *25*; α(M)=2.77×10^{-5} *4* α(N)=2.56×10^{-6} *4* POL=+0.41 *9*.
632.4 *4*	1.6 *1*	2580.4	15/2⁻	1948.0	13/2⁻				A_2=−0.35 *11*; A_4=−0.26 *21*
645.4 *2*	2.0 *2*	1713.4	11/2⁻	1068.0	9/2⁻				A_2=−0.57 *22* A_2 from (α,pnγ).
692.7 *2*	6 *1*	954.06	(7/2⁻)	261.4	3/2⁻				A_2=−0.09 *12* A_2 from (α,pnγ).
736.9 *2*	≈4[&]	954.06	(7/2⁻)	217.1	5/2⁻				A_2=−0.44 *9* A_2 from (α,pnγ).
738.5 *3*	≈5[&]	2421.4	17/2⁺	1682.8	13/2⁺				A_2=+0.39 *18* A_2 from (α,pnγ).
755.4 *3*	[@]	2468.8		1713.4	11/2⁻				
761.4 *2*	4.7 *1*	761.35	7/2⁻	0.0	3/2⁻				A_2=+0.31 *12*; A_4=+0.10 *20* A_2, A_4 from (α,pnγ).
777.2 *2*	6.7[@] *3*	2725.2	17/2⁻	1948.0	13/2⁻				A_2=+0.35 *8*
825.7 *5*	≈2[@&]	2773.9	17/2⁻	1948.0	13/2⁻				
851.0 *3*	≈32[@&]	1068.0	9/2⁻	217.1	5/2⁻				A_2=+0.28 *13* A_2 from (α,pnγ).

$^{79}_{35}$Br$_{44}$-4

γ(^{79}Br) (continued)

E_γ	I_γ[†]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	δ[‡]	Comments
867 *1*	≈3[@&]	2580.4	15/2⁻	1713.4	11/2⁻			
880.0 *3*	23.2 *5*	1948.0	13/2⁻	1068.0	9/2⁻	Q		A_2=+0.35 *5*; A_4=−0.20 *7*
886 *1*	≈2[@&]	1682.8	13/2⁺	796.80	13/2⁺			
897 *1*	1.5 *3*	1114	1/2⁻,3/2⁻	217.1	5/2⁻			
934 *1*	[#]	1332?	3/2⁻	397.79	1/2⁻,3/2⁻			
935.1 *2*	62 *1*	1731.9	17/2⁺	796.80	13/2⁺	E2		A_2=+0.34 *1*; A_4=−0.06 *2* POL=+0.43 *17*.
944.9 *4*		3366.3		2421.4	17/2⁺			
952.0 *3*	11 *1*	1713.4	11/2⁻	761.35	7/2⁻	E2		A_2=+0.14 *8*; A_4=−0.18 *12* A_2, A_4 from (α,pnγ).
973.2 *2*	12 *1*	1180.7	11/2⁺	207.5	9/2⁺	M1+E2	−2.6 *9*	A_2=−0.64 *5*; A_4=+0.16 *24* A_2, A_4 from (α,pnγ).
1070.5 *7*	2.9 *4*	3936.4		2865.9	21/2⁺			
1134.0 *2*	29 *1*	2865.9	21/2⁺	1731.9	17/2⁺	E2		A_2=+0.33 *3*; A_4=−0.20 *5*
1160.3 *3*	10.3[@] *6*	1957.1	15/2⁺	796.80	13/2⁺			A_2=−0.75 *6* A_2 from (α,pnγ).
1171.0 *3*	[@]	2902.9		1731.9	17/2⁺			
1251.0 *7*	9 *1*	4116.9	25/2⁺	2865.9	21/2⁺			A_2=+0.30 *18*
1325 *1*	≈0.6[&]	2393.1	13/2⁻	1068.0	9/2⁻			
1596.1 *3*	2.1 *2*	2393.1	13/2⁻	796.80	13/2⁺			A_2=+0.50 *16*; A_4=0.0 *3*
1624.6 *3*	1.9 *2*	2421.4	17/2⁺	796.80	13/2⁺			A_2=+0.30 *18*; A_4=+0.18 *29*
1783.8 *4*	5.8 *4*	2580.4	15/2⁻	796.80	13/2⁺	D		A_2=−0.22 *4*; A_4=+0.16 *8*

[†] From ^{78}Se(α,p2nγ) E=45 MeV. The values are from isotropic term (A0) in angular distribution function. When no $\gamma(\theta)$ data are available, values are at 125° to the beam direction. Intensities from ^{78}Se(α,pnγ) are also given.

[‡] From $\gamma(\theta)$ data and RUL (for E2 and M2 transitions).

[#] Includes contribution from ^{79}Kr ε decay.

[@] Includes contribution from an impurity.

[&] From $\gamma\gamma$ data.

[a] From BrIcc v2.3b (16-Dec-2014) 2008Ki07, "Frozen Orbitals" appr.

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

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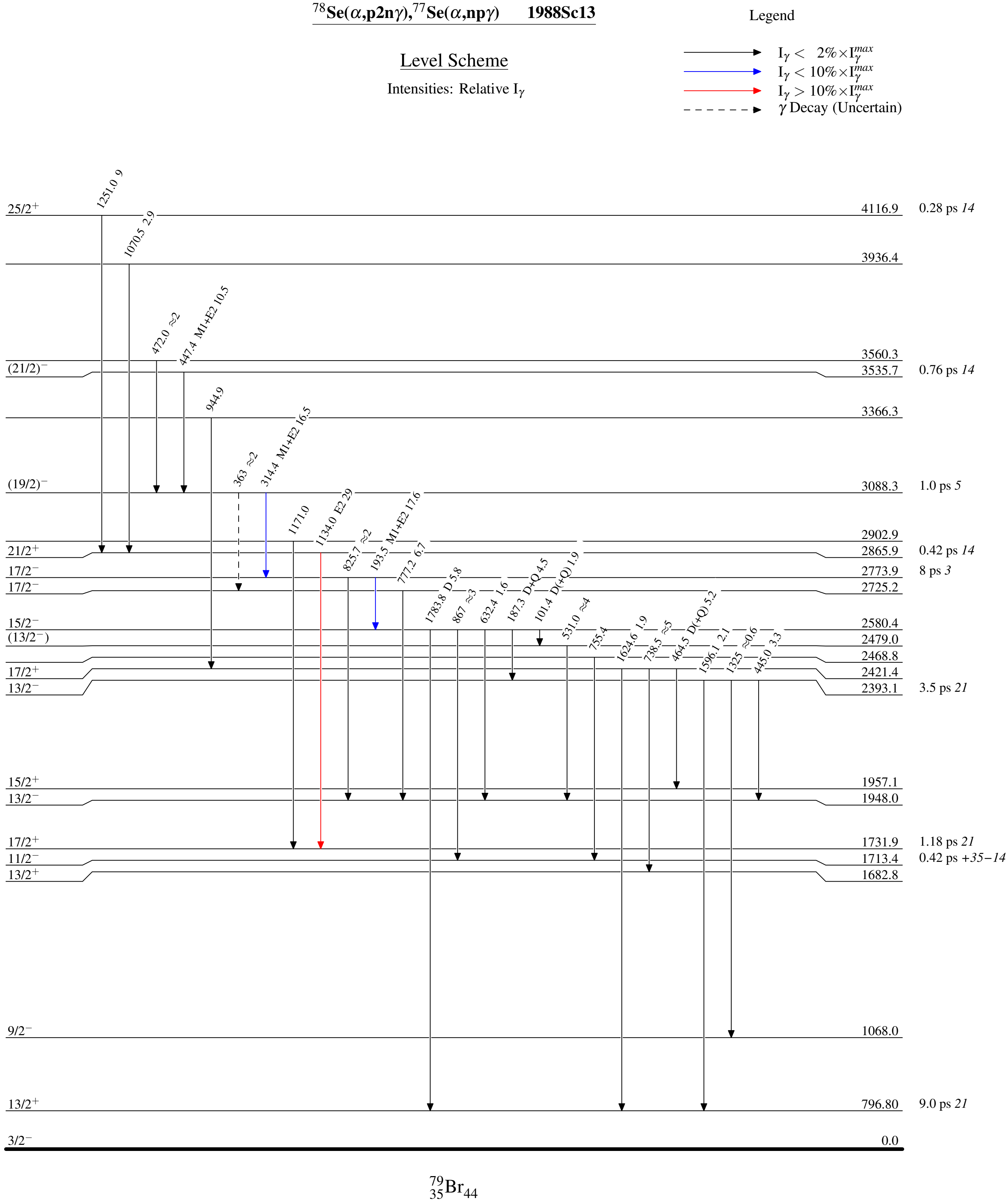
Level Scheme

Intensities: Relative I_γ



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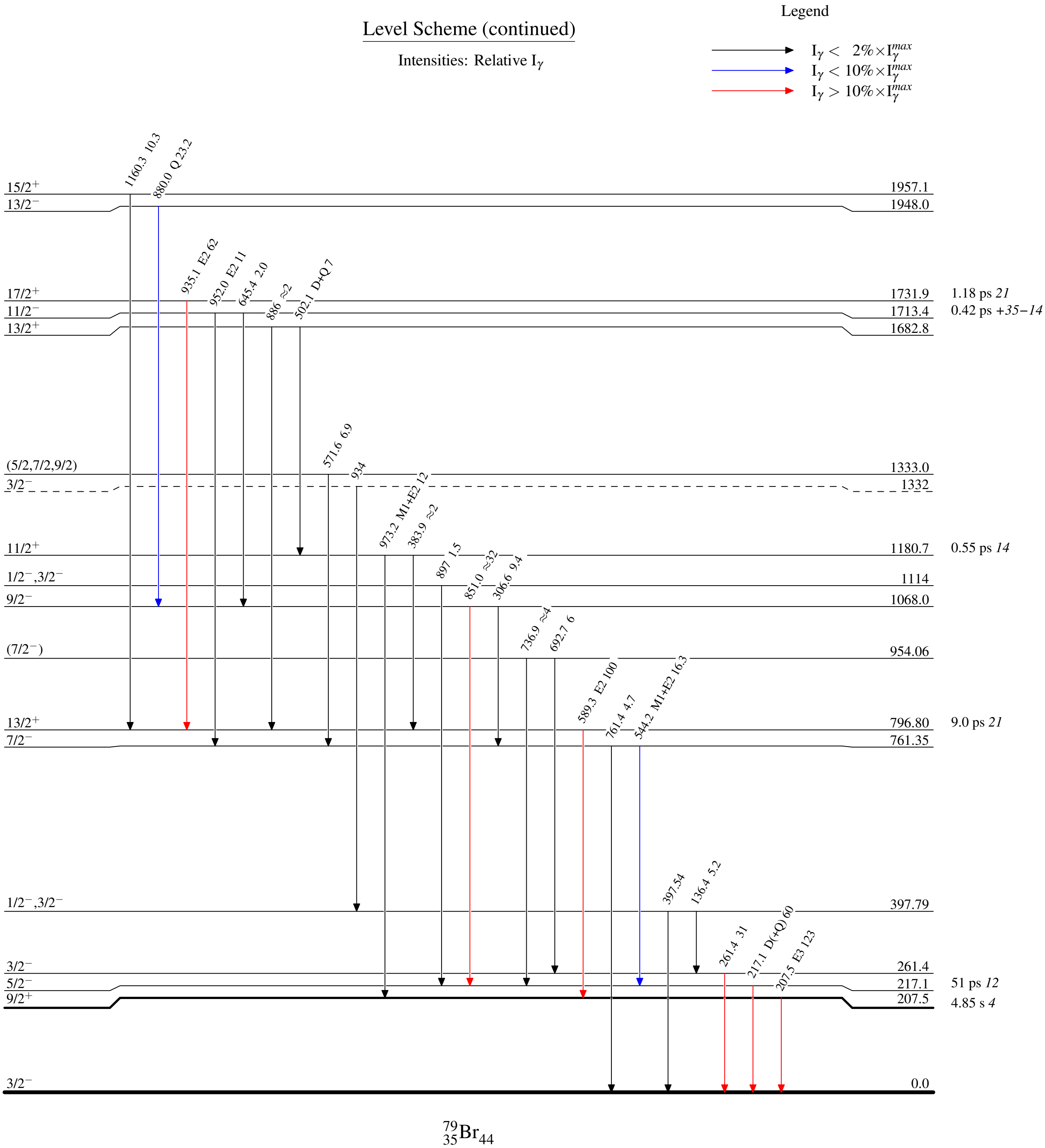
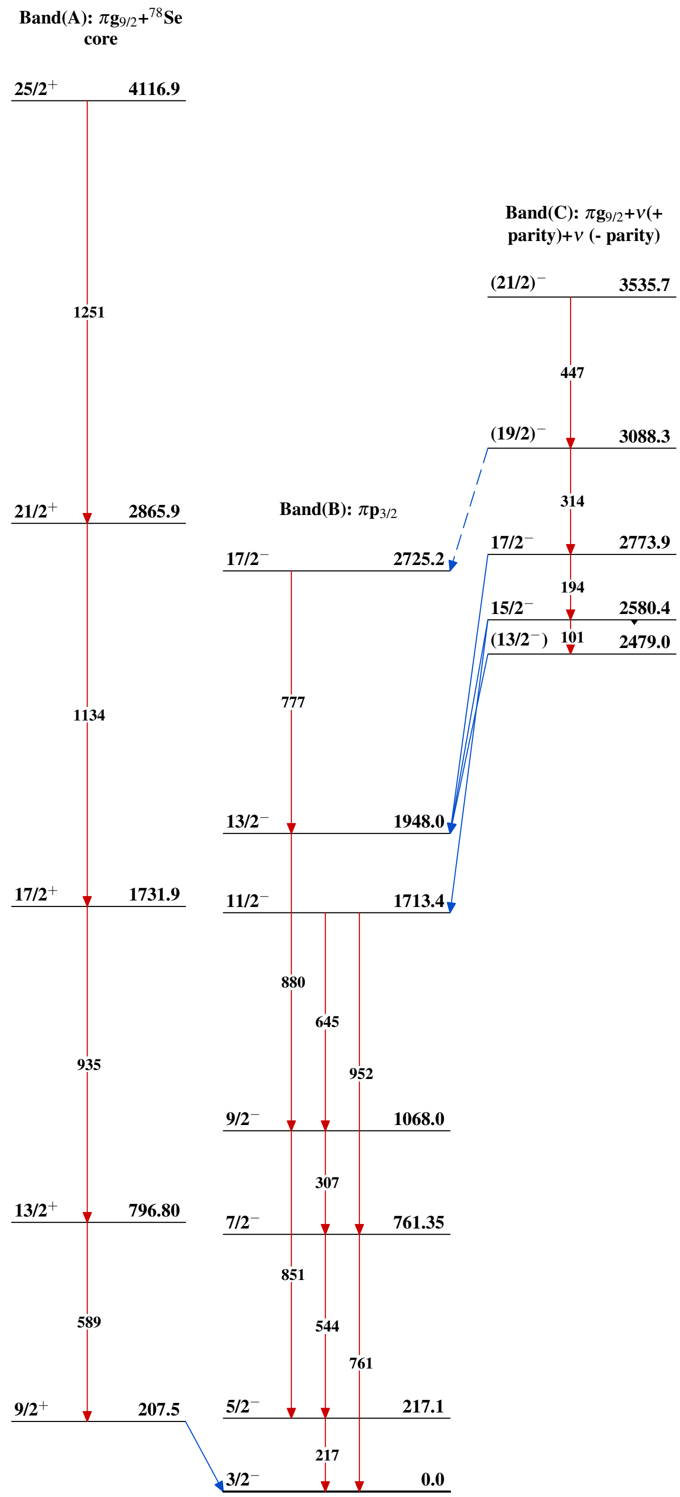
Level Scheme (continued)

Intensities: Relative I_γ



$^{78}Se(\alpha,p2n\gamma),^{77}Se(\alpha,np\gamma)$ 1988Sc13



$^{79}_{35}Br_{44}$