

(HI,xnγ) 1989My01,1979Ki17,1975CoZI

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	D. Abriola(a), A. A. Sonzogni	NDS 111,1 (2010)	1-May-2009

2008Lj01: ⁴⁰Ca(³⁶Ar,4pγ), E=136 MeV, Measured Eγ using gasp array of 38 Ge detectors. Enriched target. Measured lifetimes using recoil-distance Doppler shift (RDDS) method.

2001Pa03: ⁵⁴Fe(²⁴Mg,α2pγ)E=104 MeV. Measured Eγ, γγ and lifetimes using five Compton-suppressed HPGe detectors and a Compton-suppressed Clover detector. a separate dataset with these data is also given to preserve the gamma data.

1998Sk01: measured T_{1/2} using the Differential Decay Curve Method. The resulting values are systematically lower than other measurements and were not used to obtain adopted values.

1991Ch14: ⁴⁷Ti(²⁸Si,2pnγ), E=95 MeV, γγ coin.

1986He17: E=115 MeV; ⁶⁰Ni(¹⁴N,pn), E=39 MeV, measured lifetimes using the recoil-distance technique.

1979ki17: ⁵⁸Ni(¹⁶O,2pγ), E=42, 45, 50, 55 MeV, lifetimes by DSA and the recoil-distance method.

1977Li06: ⁵⁸Ni(¹⁶O,2pγ), E=40-58 MeV. Eγ, γγ coincidence, excit functi +t on, γ(θ), lifetimes by DSA.

1976Ha01: ⁵⁸Ni(¹⁶O,2pγ), E=46 MeV, γ singles and coincidence data, lifetimes from 4t a line-shape analysis of the Doppler-broadened lines.

Others: **1980HeZZ**, **1978Si12**, **1976Ha26**, **1975GuYW**, **1974Ha04**, **1970No03**.

⁷²Se Levels

E(level)	J ^π †	T _{1/2} ‡	Comments
0&	0 ⁺		
862.14& 9	2 ⁺	2.82 ps 20	T _{1/2} : weighted average of 2.91 ps 21 (2008Lj01), 2.4 ps 2, 2.8 ps 3 (1986He17), 3.3 ps 4 (1979Ki17), 3.6 ps 3 (1978He13), 2.0 ps 4 (1975Lo08) (recoil-distance method); and 4.0 ps 8 (line-shape analysis, 1976Ha01). Other: 1.80 ps 7 (1998Sk01).
937.38 ^a 14	0 ⁺		
1316.68 9	2 ⁺	8.7 ps 3	T _{1/2} : weighted average of 10.5 ps 10 (1979Ki17) and 8.66 ps 18 (1975Lo08).
1636.86& 14	4 ⁺	2.07 ps 16	T _{1/2} weighted average of 2.29 ps 14 (2008Lj01), 1.66 ps 17 and 1.9 ps 2 (1986He17), 2.6 ps 3 (1979Ki17), 1.9 ps 2 (1978He13) (recoil-distance method); and 3.1 ps 10 (line-shape analysis, 1976Ha01). Other: 1.46 ps 7 (1998Sk01).
1876.40 25	(2,4)		
1999.12 ^a 12	2 ⁺		
2293.70 12	(2)	<1.0 ps	
2372.03 12			
2405.74 21	3 ⁻	<1.0 ps	
2433.80 ^b 11	3 ⁻	<1.0 ps	
2466.81& 16	6 ⁺	1.24 ps 8	T _{1/2} : weighted average of 1.18 ps 7 (2008Lj01), 1.8 ps 3 and 1.5 ps 2 (1986He17); 1.1 ps 2 (1979Ki17); and 1.8 ps 5 (1976Ha01). Other: 0.97 ps 7 (1998Sk01).
2586.58 20	(3)		
3124.92 13	(4 ⁺)		
3173.24 ^b 13	5 ⁻	<1.0 ps	
3213.51 17	(2 ⁺ ,3,4 ⁺)		
3232.12 14			
3350.00 16	5 ⁻	<1.0 ps	
3382.6 3			
3424.8& 3	8 ⁺	0.51 ps 5	T _{1/2} : weighted average of 0.42 ps 9 (2001Pa03), 0.55 ps 10 (1979Ki17), 0.62 ps 17 (1977Li06) (DSA) and 0.52 ps 7 (line-shape analysis, 1976Ha01).
3522.02 15	6 ⁻	2.9 ps 3	
3770.04 15	7 ⁻	2.8 ps 2	
3917.30 ^b 15	7 ⁻	0.79 ps 17	T _{1/2} : weighted average of 0.62 ps +17-21 (2001Pa03) and 1.2 ps 2 3 (1979Ki17).
4092.8 3			
4217.7 3			
4325.7 4			
4504.3& 3	10 ⁺	0.22 ps 2	T _{1/2} : weighted average of 0.21 ps 3 (2001Pa03), 0.21 ps 3 (1979Ki17), 0.28 ps 8

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(HI,xn γ) 1989My01,1979Ki17,1975CoZI (continued)

^{72}Se Levels (continued)

E(level)	$J^{\pi\dagger}$	$T_{1/2}^{\ddagger}$	Comments
4713.24 25			(1977Li06); and 0.24 ps 5 (1976Ha01).
4762.88 ^b 20	(9 ⁻)	0.59 [@] ps 8	
5709.7 ^{&} 3	12 ⁺	0.14 ps 2	$T_{1/2}$: average of 0.15 ps +6-4 (2001Pa03), 0.12 ps 3 (1979Ki17), 0.11 ps 3 (1977Li06); and 0.17 ps 3 (1976Ha01).
5830.9 ^b 9	(11 ⁻)	0.83 [@] ps 10	
6686.5 9	(11 ⁻)		
7038.1 ^{&} 6	14 ⁺	0.097 ps 8	$T_{1/2}$: average of 0.104 ps +7-10 (2001Pa03) and 0.06 ps 2 (1977Li06).
7041.9 ^b 12	(13 ⁻)	<0.69 [@] ps	
7190.7 10	(12 ⁻)		
7795.7 14	(13 ⁻)		
8089.7 ^b 12	(14 ⁻)		
8495.2 ^{&} 12	16 ⁺	0.040 ^{#@} ps 7	
10095.2 ^{&} 15	18 ⁺	0.042 ^{#@} ps 10	
11832.2 ^{&} 18	20 ⁺	0.069 ^{#@} ps 14	
13742.2 ^{&} 21	22 ⁺	<0.05 ^{#@} ps	
15896.3 ^{&} 23	24 ⁺	<0.3 [#] ps	
18216 ^{&} 3	(26 ⁺)	<0.3 [#] ps	E(level): 1991Ch14 observed a 26 ⁺ level at 18184 3 which decays to the 24 ⁺ level.
20798 ^{&} 3	(28 ⁺)	<0.3 [#] ps	

[†] From Adopted Levels.

[‡] From recoil-distance Doppler shift method (1979Ki17), except as noted.

[#] From Doppler shift (1989My01).

[@] From 2001Pa03.

[&] Band(A): g.s. band.

^a Band(B): second 0⁺ band.

^b Band(C): negative parity.

$\gamma(^{72}\text{Se})$

E_{γ}^{\dagger}	$I_{\gamma}^{\#}$	$E_i(\text{level})$	J_i^{π}	E_f	J_f^{π}	Mult. [@]	Comments
75 ^b		937.38	0 ⁺	862.14	2 ⁺		
172.0 1	1.7 1	3522.02	6 ⁻	3350.00	5 ⁻		
248.1		3770.04	7 ⁻	3522.02	6 ⁻		E_{γ} : from 1980HeZZ.
348.8 1	3.8 1	3522.02	6 ⁻	3173.24	5 ⁻		
379.4 2	3.3 2	1316.68	2 ⁺	937.38	0 ⁺		
454.7 1	8.5 6	1316.68	2 ⁺	862.14	2 ⁺		
504.2 [‡]		7190.7	(12 ⁻)	6686.5	(11 ⁻)		
555.7 4	0.7 2	4325.7		3770.04	7 ⁻		
559.4 4	1.3 1	1876.40	(2,4)	1316.68	2 ⁺		
596.7 1	2.3 2	3770.04	7 ⁻	3173.24	5 ⁻		
605.0 [‡]		7795.7	(13 ⁻)	7190.7	(12 ⁻)		
710.1 2	0.7 2	2586.58	(3)	1876.40	(2,4)		
739.5 1	1.3 2	3173.24	5 ⁻	2433.80	3 ⁻		
744.1 1	2.3 2	3917.30	7 ⁻	3173.24	5 ⁻		
752.7 2	0.5 2	3124.92	(4 ⁺)	2372.03			
774.7 2	48.6 15	1636.86	4 ⁺	862.14	2 ⁺	E2	

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(HI,xn γ) 1989My01,1979Ki17,1975CoZI (continued) $\gamma(^{72}\text{Se})$ (continued)

E_γ †	I_γ #	E_i (level)	J_i^π	E_f	J_f^π	Mult. @	Comments
798.3 1	1.2 1	3232.12		2433.80	3 ⁻		
807.7 2	1.1 2	3213.51	(2 ⁺ ,3,4 ⁺)	2405.74	3 ⁻		
830.1 2	36.2 25	2466.81	6 ⁺	1636.86	4 ⁺	E2	
845.6 2	1.6 2	4762.88	(9 ⁻)	3917.30	7 ⁻		
862.05 15	100	862.14	2 ⁺	0	0 ⁺	E2	
879.3 ^a 2	0.9 ^a 3	3173.24	5 ⁻	2293.70	(2)		
879.3 ^a 2	0.6 ^a 3	4092.8		3213.51	(2 ⁺ ,3,4 ⁺)		
899.0 ‡		8089.7	(14 ⁻)	7190.7	(12 ⁻)		
916.1 2	0.5 1	3350.00	5 ⁻	2433.80	3 ⁻		
920.0 2	0.4 1	3213.51	(2 ⁺ ,3,4 ⁺)	2293.70	(2)		
943.2 2	1.1 1	4713.24		3770.04	7 ⁻		
958.0 2	18.8 13	3424.8	8 ⁺	2466.81	6 ⁺	E2	
977.1 1	3.9 3	2293.70	(2)	1316.68	2 ⁺		
992.8 2	0.6 2	4762.88	(9 ⁻)	3770.04	7 ⁻		
1047.8 ‡		8089.7	(14 ⁻)	7041.9	(13 ⁻)		
1055.3 1	1.2 1	2372.03		1316.68	2 ⁺		
1061.7 1	1.5 1	1999.12	2 ⁺	937.38	0 ⁺		
1068.0 ‡		5830.9	(11 ⁻)	4762.88	(9 ⁻)		
1079.5 1	9.4 6	4504.3	10 ⁺	3424.8	8 ⁺	E2	
1088.9 ^a 3	4.3 ^a 15	2405.74	3 ⁻	1316.68	2 ⁺		
1088.9 ^a 3	1.6 ^a 7	3382.6		2293.70	(2)		
1117.2 1	1.3 1	2433.80	3 ⁻	1316.68	2 ⁺		
1125.7 1	0.9 1	3124.92	(4 ⁺)	1999.12	2 ⁺		
1136.9 1	2.1 1	1999.12	2 ⁺	862.14	2 ⁺		
1205.4 2	2.6 1	5709.7	12 ⁺	4504.3	10 ⁺	E2	
1211.0 ‡		7041.9	(13 ⁻)	5830.9	(11 ⁻)		
1303.3 1	5.9 2	3770.04	7 ⁻	2466.81	6 ⁺		
1316.7 1	9.4 3	1316.68	2 ⁺	0	0 ⁺	E2	
1328.4 5		7038.1	14 ⁺	5709.7	12 ⁺	E2	
1338.3 ‡		4762.88	(9 ⁻)	3424.8	8 ⁺		
1359.8 ‡		7190.7	(12 ⁻)	5830.9	(11 ⁻)		
1431.2 2	3.4 1	2293.70	(2)	862.14	2 ⁺		
1450.3 2	1.8 5	3917.30	7 ⁻	2466.81	6 ⁺		I_γ : from $\gamma\gamma$ spectra.
1457 ‡		8495.2	16 ⁺	7038.1	14 ⁺	E2&	
1536.1 3	7.1 3	3173.24	5 ⁻	1636.86	4 ⁺		
1571.6 1	5.2 3	2433.80	3 ⁻	862.14	2 ⁺		
1576.5 2	1.0 2	3213.51	(2 ⁺ ,3,4 ⁺)	1636.86	4 ⁺		
1595.3 2	1.3 2	3232.12		1636.86	4 ⁺		
1600 ‡		10095.2	18 ⁺	8495.2	16 ⁺	E2&	
1713.0	4.3 3	3350.00	5 ⁻	1636.86	4 ⁺		
1724.5 2	1.0 2	2586.58	(3)	862.14	2 ⁺		
1737 ‡		11832.2	20 ⁺	10095.2	18 ⁺	E2&	E_γ : 1731 in 1991Ch14.
1750.9 2	1.2 2	4217.7		2466.81	6 ⁺		
1808.8 2	1.4 2	3124.92	(4 ⁺)	1316.68	2 ⁺		
1910 ‡		13742.2	22 ⁺	11832.2	20 ⁺	E2&	
1923.6 ‡		6686.5	(11 ⁻)	4762.88	(9 ⁻)		
2154 ‡		15896.3	24 ⁺	13742.2	22 ⁺	E2&	
2320 ‡		18216	(26 ⁺)	15896.3	24 ⁺	(E2)&	
2582 ‡		20798	(28 ⁺)	18216	(26 ⁺)	(E2)&	

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(HI,xn γ) 1989My01,1979Ki17,1975CoZI (continued)

$\gamma(^{72}\text{Se})$ (continued)

† Except as noted otherwise, the energies are mainly from 1975CoZI; however, weighted averages of values of 1977Li06 and 1975CoZI are given where available.

‡ From 1989My01.

From $^{58}\text{Ni}(^{16}\text{O},2p\gamma)$ at E=45.5 MeV, $\theta(\gamma)=55^\circ$ (1975CoZI).

@ Mult=E2 from $\gamma(\theta)$ in 1977Li06 and RUL.

& Stretched Q transitions from DCO ratios ≈ 1 (1989My01). Evaluators assume these are E2.

^a Multiply placed with intensity suitably divided.

^b Placement of transition in the level scheme is uncertain.

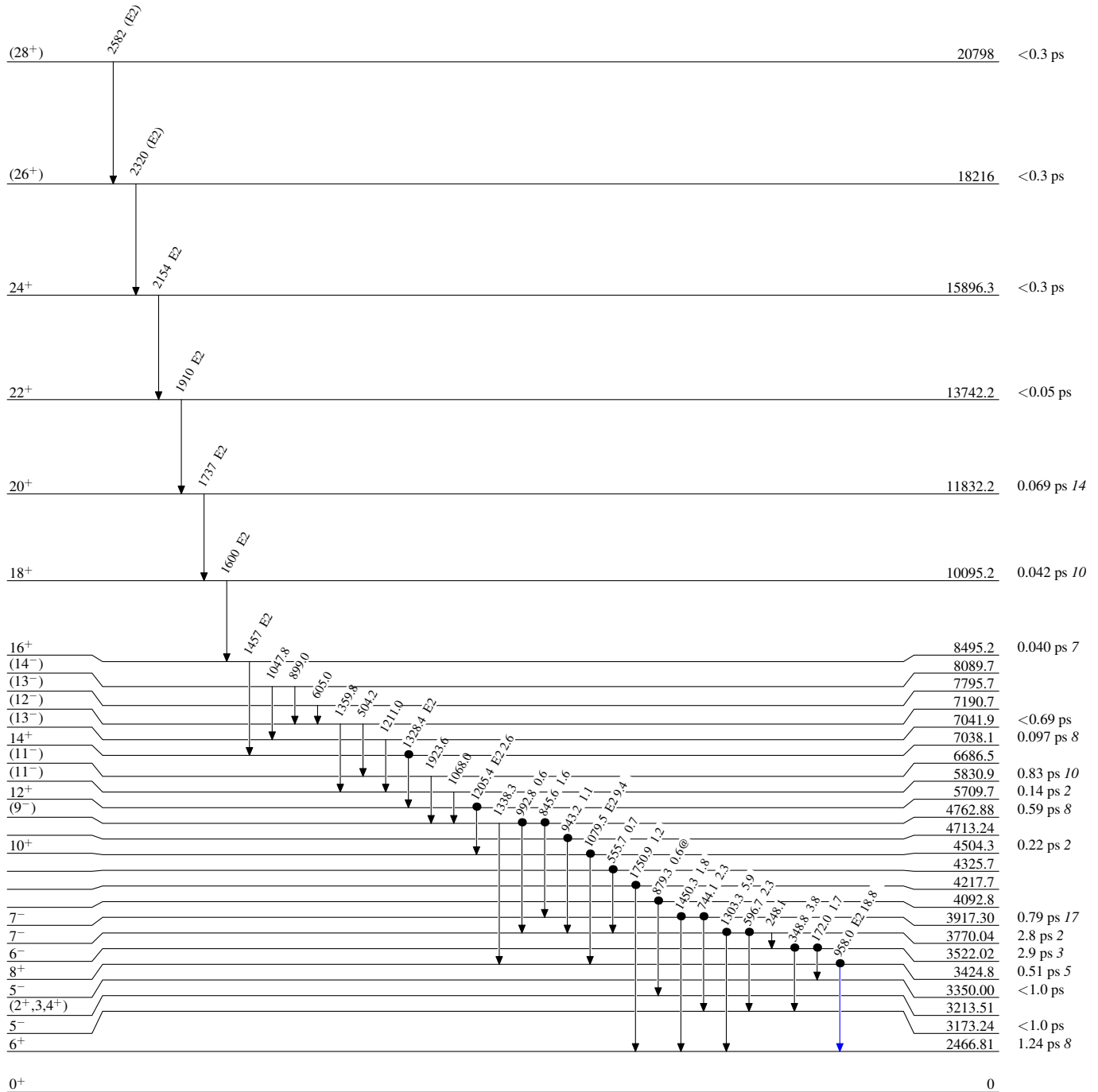
(HI,xn γ) 1989My01,1979Ki17,1975CoZI

Level Scheme

Intensities: Relative I γ
@ Multiply placed: intensity suitably divided

Legend

- I γ < 2% × I γ^{max}
- I γ < 10% × I γ^{max}
- I γ > 10% × I γ^{max}
- Coincidence



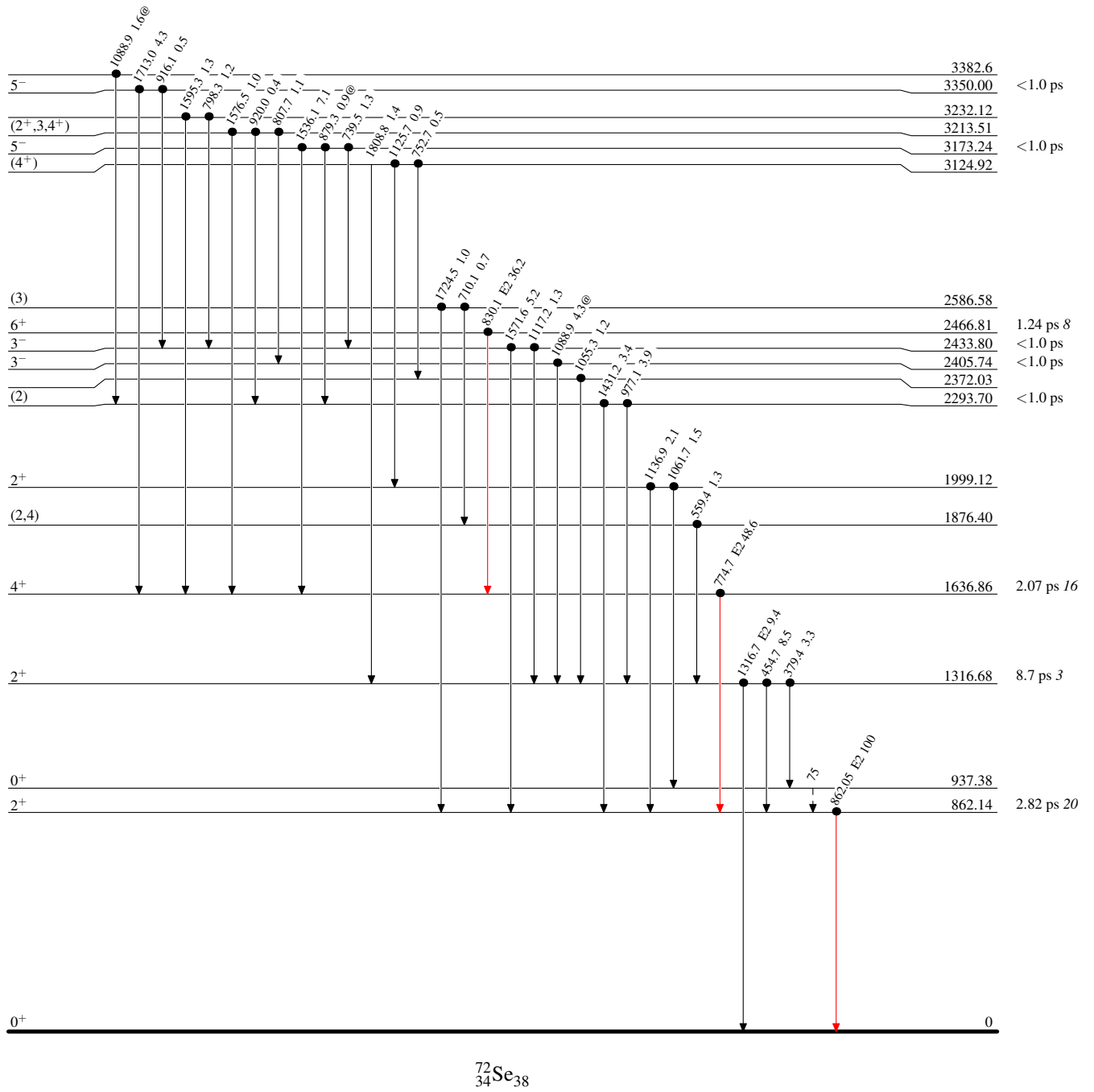
(HI,xn γ) 1989My01,1979Ki17,1975CoZI

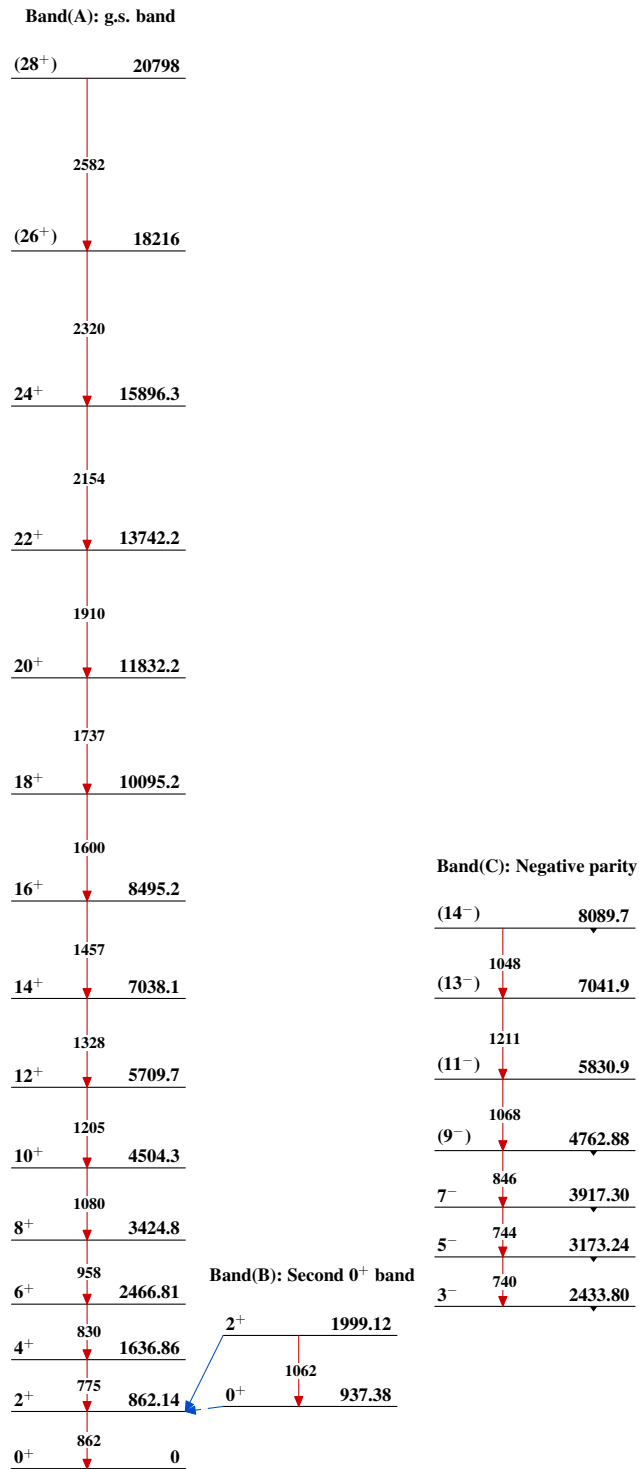
Legend

Level Scheme (continued)

Intensities: Relative I_γ
@ Multiply placed: intensity suitably divided

- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- - - - γ Decay (Uncertain)
- Coincidence



(HI,xn γ) 1989My01,1979Ki17,1975CoZI $^{72}_{34}\text{Se}_{38}$