Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 188,1 (2023)	17-Jan-2023

Q(β^-)=−6644 *6*; S(n)=9288 *3*; S(p)=6102 *3*; Q(α)=−2898 *5* 2021Wa16
S(2n)=22854 *3*, S(2p)=10624 *3*, Q(εp)=126.6 *29*, Q(ε)=4747 *5* (2021Wa16).
1957Be43: identification and production of ^{71}Se from Cu(^{14}N,X) reaction, measured half-life.
1957At37: identification and production of ^{71}Se from ^{70}Ge(α,3n) reaction, measured half-life.
Mass measurements: 2021Ma22, 2002Li24, 2001Ha66, 1998Ch20.
Theoretical calculations:
2015Ka46: calculated low- and high-spin levels, J^π, B(E2) using shell-model with a pairing-plus-multipole Hamiltonian and monopole-based universal force interaction (PMMU model).
1989Sa34: calculated levels, B(λ) using deformed configuration mixing model.

^{71}Se Levels

Q(transition) values are from ^{54}Fe(^{23}Na,pn$\alpha\gamma$), deduced by 2012Ho16.

Cross Reference (XREF) Flags

A ^{71}Br ε decay (21.4 s)
B ^{54}Fe(^{23}Na,np$\alpha\gamma$)
C ^{58}Ni(^{16}O,2pnγ)

E(level)†	J$^\pi$‡	T$_{1/2}$#	XREF	Comments
0.0	(5/2$^-$)	4.74 min *5*	ABC	%ε+%β^+=100 J$^\pi$: log *ft*=5.8 to 5/2$^-$ and log *ft*=5.9 to 3/2$^-$; observed feeding with log $f^{1u}t$=9.0 to 9/2$^+$ rules out 3/2$^-$. T$_{1/2}$: from γ-decay curve in a well-type NaI detector (1980Te01). Others: 5.6 min *15* (1971Do01), 4.93 min *10* (1969Hu13), 5 min *2* (1957Be43), 4.5 min *5* (1957At37).
48.78 *5*	(1/2$^-$)	5.6 μs *7*	ABC	%IT=100 J$^\pi$: E2 γ to (5/2$^-$); systematic occurrence of low-lying p$_{1/2}$ orbital in neighboring nuclides. T$_{1/2}$: from $\gamma\gamma$(t) and γ(x ray)(t) in ε decay.
171.52 *6*	(3/2$^-$)		AB	J$^\pi$: ΔJ=1 γs to (5/2$^-$) and (1/2$^-$).
260.48@ *10*	(9/2$^+$)	19.0 μs *5*	ABC	%IT=100 T$_{1/2}$: from 260γ(t) (2000Ch07), ^{71}Se formed in fragmentation of ^{92}Mo beam at 60 MeV/nucleon with a nickel target at GANIL facility. Other: 19 μs *3* from $\gamma\gamma$(t) in ε decay (1982Ha32).
282.47 *7*	(3/2$^-$)		ABC	J$^\pi$: ΔJ=1 γs to (5/2$^-$) and (1/2$^-$).
647.80 *18*	(5/2$^+$,7/2,9/2$^-$)		A	J$^\pi$: γs to (5/2$^-$) and (9/2$^+$).
756.98 *15*	(5/2$^-$)		ABC	J$^\pi$: ΔJ=0 756.9 γ to (5/2$^-$); ΔJ=1 474.6 γ to (3/2$^-$).
796.8a *4*	(5/2$^-$)		AB	J$^\pi$: ΔJ=0 796.7γ to (5/2$^-$).
1040.67b *12*	(7/2$^-$)	1.0 ps *7*	BC	J$^\pi$: ΔJ=2, E2 758γ to (3/2$^-$). T$_{1/2}$: from DSAM in ^{58}Ni(^{16}O,2pnγ) (1984EbZZ).
1154.6& *3*	(11/2$^+$)		BC	J$^\pi$: (M1+E2) γ to (9/2$^+$), νg$_{9/2}$ band member.
1233.0 *3*	(9/2$^-$)		BC	J$^\pi$: ΔJ=2 γ to (5/2$^-$).
1297.8@ *3*	(13/2$^+$)	0.90 ps *28*	BC	J$^\pi$: ΔJ=2, E2 γ to (9/2$^+$), band member. T$_{1/2}$: from DSAM in ^{58}Ni(^{16}O,2pnγ) (1984EbZZ). Other: >1.4 ps in (^{23}Na,pn$\alpha\gamma$). Q(transition)<1.25 (2012Ho16).
1378.67a *25*	(9/2$^-$)		BC	J$^\pi$: ΔJ=(2) γ to (5/2$^-$); possible band member.

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Adopted Levels, Gammas (continued)

^{71}Se Levels (continued)

E(level)[†]	Jπ[‡]	$T_{1/2}$[#]	XREF	Comments
1680.7[b] *4*	(11/2⁻)	1.7 ps *7*	BC	Jπ: ΔJ=2, E2 γ to (7/2⁻). $T_{1/2}$: from DSAM in ^{58}Ni(^{16}O,2pnγ) (1984EbZZ).
2066.2[a] *3*	(13/2⁻)		B	Jπ: ΔJ=2 γ to (9/2⁻).
2417.9[&] *4*	(15/2⁺)	0.27 ps *+8–7*	BC	Q(transition)=1.63 *+26–19* (2012Ho16). Jπ: γ to (11/2⁺), band member.
2448.3[@] *3*	(17/2⁺)	0.534 ps *+42–35*	BC	Q(transition)=1.40 *5* (2012Ho16). Jπ: ΔJ=(2), (E2) γ to (13/2⁺), band member. $T_{1/2}$: other: 0.53 ps *21* from DSAM in ^{58}Ni(^{16}O,2pnγ) (1984EbZZ).
2481.6[b] *4*	(15/2⁻)	0.53 ps *28*	BC	Jπ: ΔJ=(2), (E2) γ to (11/2⁻), band member. $T_{1/2}$: from DSAM in ^{58}Ni(^{16}O,2pnγ) (1984EbZZ). Other: >1.4 ps in (^{23}Na,pnαγ).
2975.8[a] *4*	(17/2⁻)	0.82 ps *8*	BC	Q(transition)=2.04 *+10–9* (2012Ho16). Jπ: ΔJ=(2), (E2) γ to (13/2⁻), band member.
3323.3 *4*	(17/2⁻)		B	Jπ: ΔJ=1 γ to (15/2⁻).
3427.1[b] *5*	(19/2⁻)	0.638 ps *21*	BC	Q(transition)=2.03 *3* (2012Ho16). Jπ: ΔJ=(2), (E2) γ to (15/2⁻), band member. $T_{1/2}$: other: <0.7 ps from DSAM in ^{58}Ni(^{16}O,2pnγ) (1984EbZZ).
3451.5[&] *4*	(19/2⁺)	0.30 ps *+8–6*	BC	Q(transition)=2.01 *+25–23* (2012Ho16). Jπ: ΔJ=(2), (E2) γ to (15/2⁺), band member.
3521.4 *4*	(19/2⁻)		B	Jπ: ΔJ=1, dipole γ to (17/2⁺). Possible 3-qp state formed by coupling of $g_{9/2}$ neutron to 5⁻ state at 3387 keV in ^{70}Se (2012Ho16).
3635.2[@] *4*	(21/2⁺)	0.284 ps *14*	BC	Jπ: ΔJ=(2), (E2) γ to (17/2⁺), band member. $T_{1/2}$: other: 0.40 ps *28* from DSAM in ^{58}Ni(^{16}O,2pnγ) (1984EbZZ).
3989.1 *4*	(21/2⁻)		B	Jπ: ΔJ=1 γ to (19/2⁻).
4039.4[a] *4*	(21/2⁻)	0.485 ps *14*	BC	Q(transition)=1.70 *2* (2012Ho16). Jπ: γ to (17/2⁻), band member.
4254.3 *5*	(23/2⁻)		B	Jπ: ΔJ=1 γ to (21/2⁻); γ to (19/2⁻).
4497.2[&] *7*	(23/2⁺)	<0.80 ps	BC	Q(transition)>1.07 (2012Ho16). Jπ: ΔJ=(2), (E2) γ to (19/2⁺), band member.
4504.9[b] *7*	(23/2⁻)	0.333 ps *14*	BC	Q(transition)=1.95 *4* (2012Ho16). Jπ: ΔJ=2, E2 γ to (19/2⁻), band member.
4834.4[@] *7*	(25/2⁺)	0.326 ps *28*	BC	Q(transition)=1.46 *+7–6* (2012Ho16). Jπ: γ to (21/2⁺), band member.
5240.3[a] *11*	(25/2⁻)	<0.17 ps	B	Q(transition)>2.08 (2012Ho16). Jπ: γ to (21/2⁻), band member.
5645.6[b] *7*	(27/2⁻)	0.395 ps *35*	B	Q(transition)=1.52 *+7–6* (2012Ho16). Jπ: γ to (23/2⁻), band member.
5686.8[&] *8*	(27/2⁺)		B	Jπ: γ to (23/2⁺), band member.
6036.4[@] *13*	(29/2⁺)	0.374 ps *28*	BC	Q(transition)=1.36 *5* (2012Ho16). Jπ: γ to (25/2⁺), band member.
6340.5 *8*	(29/2⁺)		B	Jπ: γ to (25/2⁺); γ to (27/2⁺).
6947.6[b] *11*	(31/2⁻)	<0.17 ps	B	Q(transition)>1.66 (2012Ho16). Jπ: γ to (27/2⁻), band member.
7375.6[@] *16*	(33/2⁺)	<0.09 ps	B	Jπ: γ to (29/2⁺), band member. Q(transition)>2.09 (2012Ho16).

[†] From a least-squares fit to Eγ data.

[‡] For levels above 200 keV populated in ^{54}Fe(^{23}Na,pnαγ), assignments are based on γγ(θ)(DCO) data, and band structures,

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{71}Se Levels (continued)

complemented by lifetime measurements for many levels.

From DSAM in ^{54}Fe(^{23}Na,pn$\alpha\gamma$) (2012Ho16), unless otherwise stated.

@ Band(A): $\nu g_{9/2}$ band,α=+1/2. Interpreted as an oblate deformed because of the negative sign of Q_0 deduced from sign(δ)=sign((g_K-g_R)/Q_0) for the transition $11/2^+$ to $9/2^+$ deduced from δ=+1.3 (1988Wi02).

& Band(a): $\nu g_{9/2}$ band,α=−1/2.

a Band(B): Band based on $(5/2^-)$.

b Band(C): Band based on $(7/2^-)$.

Adopted Levels, Gammas (continued)

γ(^{71}Se)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[#]	δ	α[@]	Comments
48.78	(1/2$^-$)	48.78[‡] *5*	100	0.0	(5/2$^-$)	E2		11.86	B(E2)(W.u.)=1.63 *+23−18* Mult.: from α(K)exp in ^{71}Br ε decay.
171.52	(3/2$^-$)	122.72[‡] *5*	83[‡] *7*	48.78	(1/2$^-$)	D+Q			
		171.6[‡] *1*	100[‡] *8*	0.0	(5/2$^-$)	D+Q			
260.48	(9/2$^+$)	260.5[‡] *1*	100	0.0	(5/2$^-$)	[M2]		0.0405	B(M2)(W.u.)=0.0763 *20*
282.47	(3/2$^-$)	233.8 *1*	100 *8*	48.78	(1/2$^-$)	D+Q			E_γ: weighted average of 233.7 *1* in ε decay and 233.9 *1* in (^{23}Na,pnαγ). I_γ: from ε decay. Other: 100 *17* from (^{23}Na,pnαγ).
		282.4[‡] *1*	40 *8*	0.0	(5/2$^-$)	(D+Q)			E_γ: other: 282.4 *3* from (^{23}Na,pnαγ). I_γ: weighted average of 38 *8* in ε decay and 50 *17* in (^{23}Na,pnαγ).
647.80	(5/2$^+$,7/2,9/2$^-$)	387.4[‡] *2*	100[‡] *14*	260.48	(9/2$^+$)				
		647.6[‡] *3*	71[‡] *14*	0.0	(5/2$^-$)				
756.98	(5/2$^-$)	474.6[‡] *2*	54 *8*	282.47	(3/2$^-$)	D+Q			E_γ: other: 474.5 *6* from (^{23}Na,pnαγ). I_γ: weighted average of 52 *8* from ^{71}Br ε decay and 58 *13* from (^{23}Na,pnαγ).
		756.9[‡] *2*	100[‡] *10*	0.0	(5/2$^-$)	D+Q			E_γ,I_γ: other: 756.9 *6* with Iγ=100 *17* from (^{23}Na,pnαγ).
796.8	(5/2$^-$)	796.7 *4*	100	0.0	(5/2$^-$)	D+Q			E_γ: weighted average of 796.4 *4* from ^{71}Br ε decay and 797.1 *5* from (^{23}Na,pnαγ).
1040.67	(7/2$^-$)	758.2 *1*	74 *13*	282.47	(3/2$^-$)	E2			B(E2)(W.u.)=51 *+57−23* Mult.: ΔJ=2, Q from (^{23}Na,pnαγ); M2 ruled out by RUL.
		868.9 *8*	13 *4*	171.52	(3/2$^-$)	[E2]			B(E2)(W.u.)=4.5 *+53−23*
		1040.6 *4*	100 *18*	0.0	(5/2$^-$)	(M1+E2)			B(M1)(W.u.)=0.010 *+12−5*; B(E2)(W.u.)=14 *+16−6* B(M1)(W.u.) for pure M1, and B(E2)(W.u.) for pure E2. Mult.: ΔJ=1, D+Q from (^{23}Na,pnαγ); (M1+E2) from level scheme.
1154.6	(11/2$^+$)	894.1 *3*	100	260.48	(9/2$^+$)	(D+Q)	+1.6 *3*		δ: from 1988Wi02 in (^{16}O,2pnγ) dataset. Mult.: large mixing ratio suggests M1+E2 in contrast to E1+M2.
1233.0	(9/2$^-$)	1233.0 *4*	100	0.0	(5/2$^-$)	Q			In (^{16}O,2pnγ), this γ was assigned from a 1493 level to 261 level.
1297.8	(13/2$^+$)	143.2 *7*	0.9 *5*	1154.6	(11/2$^+$)	[M1]			B(M1)(W.u.)=0.07 *+6−4* Mult.: no significant admixture of E2 expected from B(E2)(W.u.).
		1037.3 *3*	100	260.48	(9/2$^+$)	E2			B(E2)(W.u.)=30 *+13−7*
1378.67	(9/2$^-$)	581.6 *5*	30 *6*	796.8	(5/2$^-$)	(Q)			
		621.8 *5*	35 *8*	756.98	(5/2$^-$)	(Q)			

Adopted Levels, Gammas (continued)

γ(^{71}Se) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[#]	Comments
1378.67	(9/2$^-$)	1378.7 *4*	100 *38*	0.0	(5/2$^-$)	(Q)	In (^{16}O,2pnγ), this γ was assigned from a 1639 level to 261 level.
1680.7	(11/2$^-$)	640.1 *4*	100	1040.67	(7/2$^-$)	E2	B(E2)(W.u.)=1.8×10^2 *+12−5* Mult.: Q, ΔJ=2 from DCO in (^{23}Na,pn$\alpha\gamma$); M2 ruled out by RUL.
2066.2	(13/2$^-$)	687.5 *2*	50 *7*	1378.67	(9/2$^-$)	Q	In (^{16}O,2pnγ), this γ was assigned from 2327 level to 1639 level.
		833.2 *3*	100 *14*	1233.0	(9/2$^-$)	Q	In (^{16}O,2pnγ), this γ was assigned from 2327 level to 1494 level.
2417.9	(15/2$^+$)	1120.1 *5*	100 *22*	1297.8	(13/2$^+$)	[M1,E2]	B(M1)(W.u.)=0.031 *+12−8*; B(E2)(W.u.)=36 *+15−10* B(M1)(W.u.) for pure M1, and B(E2)(W.u.) for pure E2.
		1263.3 *6*	89 *22*	1154.6	(11/2$^+$)	[E2]	B(E2)(W.u.)=18 *+7−5*
2448.3	(17/2$^+$)	1150.5 *1*	100	1297.8	(13/2$^+$)	(E2)	B(E2)(W.u.)=30.0 *21*
2481.6	(15/2$^-$)	800.9 *3*	100	1680.7	(11/2$^-$)	(E2)	B(E2)(W.u.)=1.9×10^2 *+17−7*
2975.8	(17/2$^-$)	909.6 *2*	100	2066.2	(13/2$^-$)	(E2)	B(E2)(W.u.)=63 *7* In (^{16}O,2pnγ), this γ was assigned from 3237 level to 2327 level.
3323.3	(17/2$^-$)	841.7 *5*	100	2481.6	(15/2$^-$)	D+Q	
3427.1	(19/2$^-$)	945.5 *3*	100	2481.6	(15/2$^-$)	(E2)	B(E2)(W.u.)=67.3 *22*
3451.5	(19/2$^+$)	1003.2 *4*	100 *18*	2448.3	(17/2$^+$)		B(M1)(W.u.)=0.038 *+14−10*; B(E2)(W.u.)=56 *+21−15* B(M1)(W.u.) for pure M1, and B(E2)(W.u.) for pure E2.
		1033.6 *4*	91 *36*	2417.9	(15/2$^+$)	(E2)	B(E2)(W.u.)=44 *15*
3521.4	(19/2$^-$)	198.1 *4*	8.5 *23*	3323.3	(17/2$^-$)		
		1073.1 *4*	100 *15*	2448.3	(17/2$^+$)	D	
3635.2	(21/2$^+$)	1186.9 *3*	100	2448.3	(17/2$^+$)	(E2)	B(E2)(W.u.)=48 *3*
3989.1	(21/2$^-$)	467.7 *2*	100 *25*	3521.4	(19/2$^-$)		
		562.0 *4*	50 *13*	3427.1	(19/2$^-$)	D+Q	
		665.8 *2*	38 *13*	3323.3	(17/2$^-$)		
		1013.3 *9*	38 *25*	2975.8	(17/2$^-$)		
4039.4	(21/2$^-$)	1063.6 *2*	100	2975.8	(17/2$^-$)	[E2]	B(E2)(W.u.)=49.1 *14* In (^{16}O,2pnγ), this γ was assigned from a 4301 level to a 3237 level.
4254.3	(23/2$^-$)	265.2 *4*	77 *37*	3989.1	(21/2$^-$)	(D+Q)	
		732.9 *6*	100 *33*	3521.4	(19/2$^-$)		
4497.2	(23/2$^+$)	862.0 *10*	42 *16*	3635.2	(21/2$^+$)	[M1,E2]	B(M1)(W.u.)>0.0078; B(E2)(W.u.)>15 B(M1)(W.u.) for pure M1, and B(E2)(W.u.) for pure E2.
		1045.7 *7*	100 *16*	3451.5	(19/2$^+$)	(E2)	B(E2)(W.u.)>19
4504.9	(23/2$^-$)	1077.7 *5*	100	3427.1	(19/2$^-$)	E2	B(E2)(W.u.)=67 *3*
4834.4	(25/2$^+$)	337.2 *6*	6 *4*	4497.2	(23/2$^+$)	[M1]	B(M1)(W.u.)=0.11 *+8−5* Mult.: no significant admixture of E2 expected from B(E2)(W.u.).
		1199.2 *10*	100 *25*	3635.2	(21/2$^+$)	[E2]	B(E2)(W.u.)=38 *4*
5240.3	(25/2$^-$)	1200.9 *10*	100	4039.4	(21/2$^-$)	[E2]	B(E2)(W.u.)>76
5645.6	(27/2$^-$)	1140.7 *1*	100	4504.9	(23/2$^-$)	[E2]	B(E2)(W.u.)=43 *4*
5686.8	(27/2$^+$)	1189.6 *8*	100	4497.2	(23/2$^+$)		
6036.4	(29/2$^+$)	1202.0 *10*	100	4834.4	(25/2$^+$)	[E2]	B(E2)(W.u.)=35 *3*
6340.5	(29/2$^+$)	653.7 *3*	100 *25*	5686.8	(27/2$^+$)		
		1506.1 *3*	100 *50*	4834.4	(25/2$^+$)		

$^{71}_{34}Se_{37}$-5

Adopted Levels, Gammas (continued)

γ(^{71}Se) (continued)

E_i(level)	J_i^π	E_γ †	I_γ †	E_f	J_f^π	Mult. #	Comments
6947.6	(31/2$^-$)	1302.0 *8*	100	5645.6	(27/2$^-$)	[E2]	B(E2)(W.u.)>51
7375.6	(33/2$^+$)	1339.2 *10*	100	6036.4	(29/2$^+$)	[E2]	B(E2)(W.u.)>83

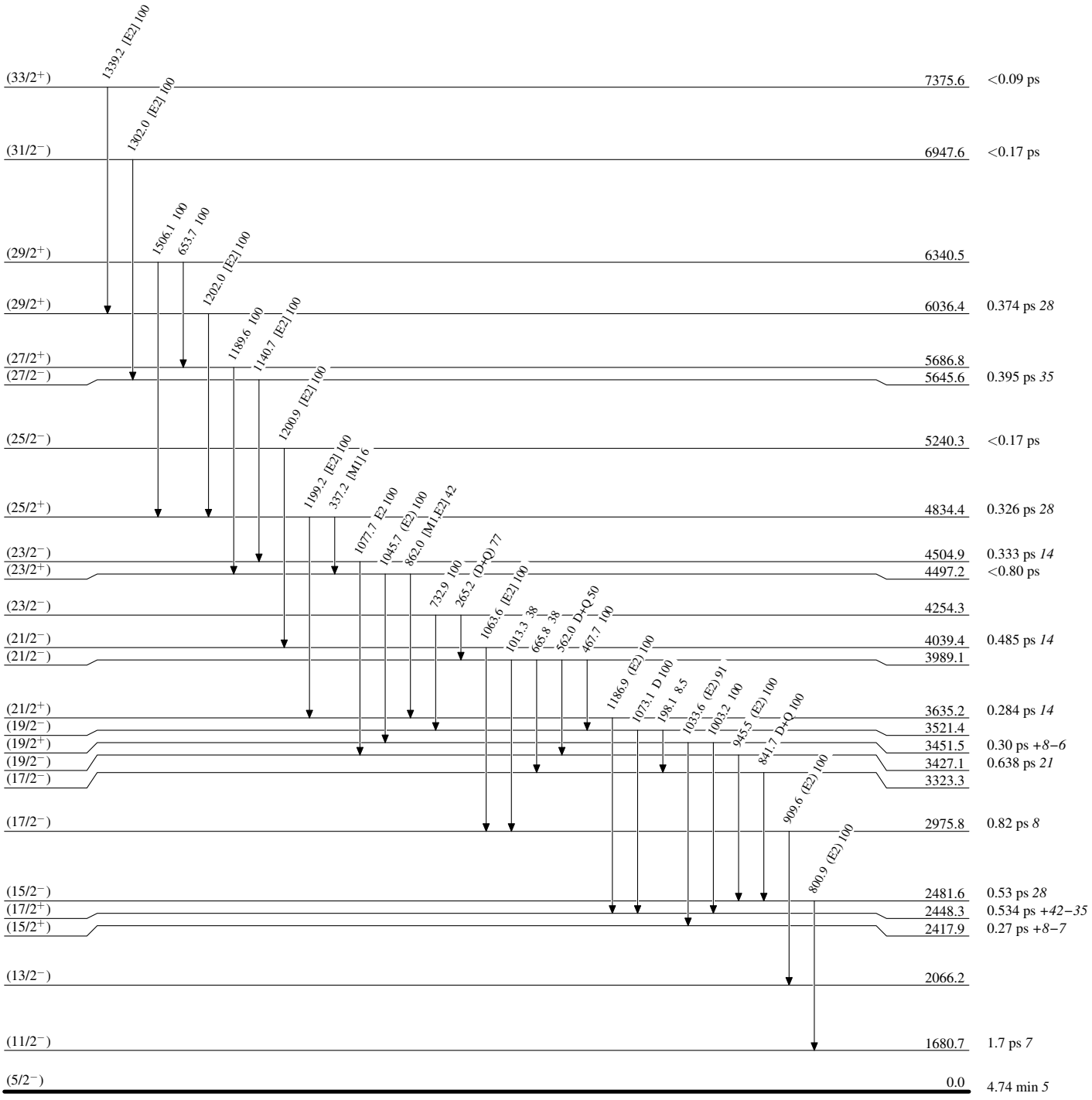
† From ^{54}Fe(^{23}Na,pn$\alpha\gamma$), unless otherwise noted.
‡ From ^{71}Br ε decay.
# From $\gamma\gamma(\theta)$(DCO) data in (^{23}Na,pn$\alpha\gamma$), unless otherwise noted.
@ Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

$^{71}_{34}Se_{37}$-6

Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level

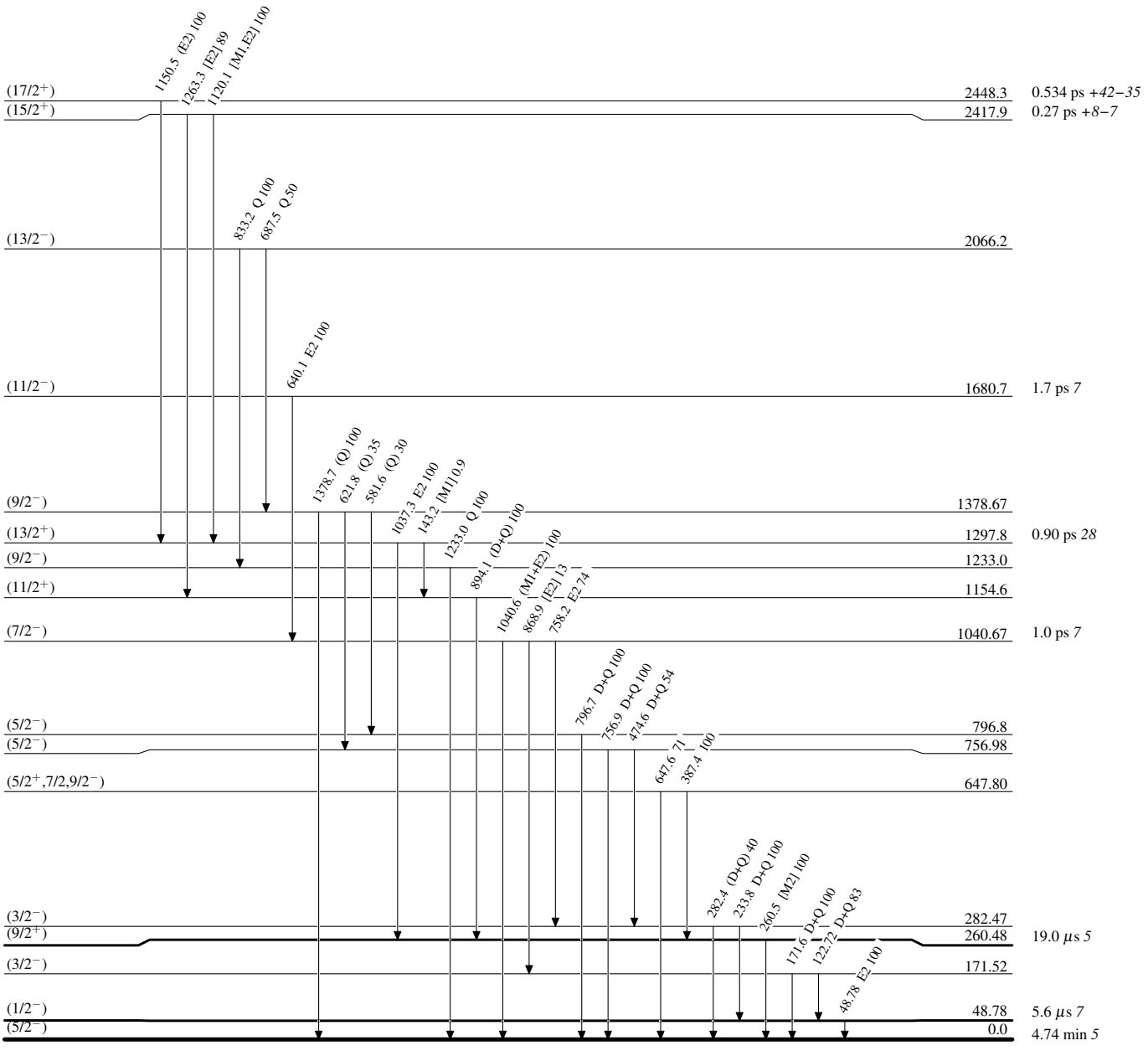


$^{71}_{34}Se_{37}$

Adopted Levels, Gammas

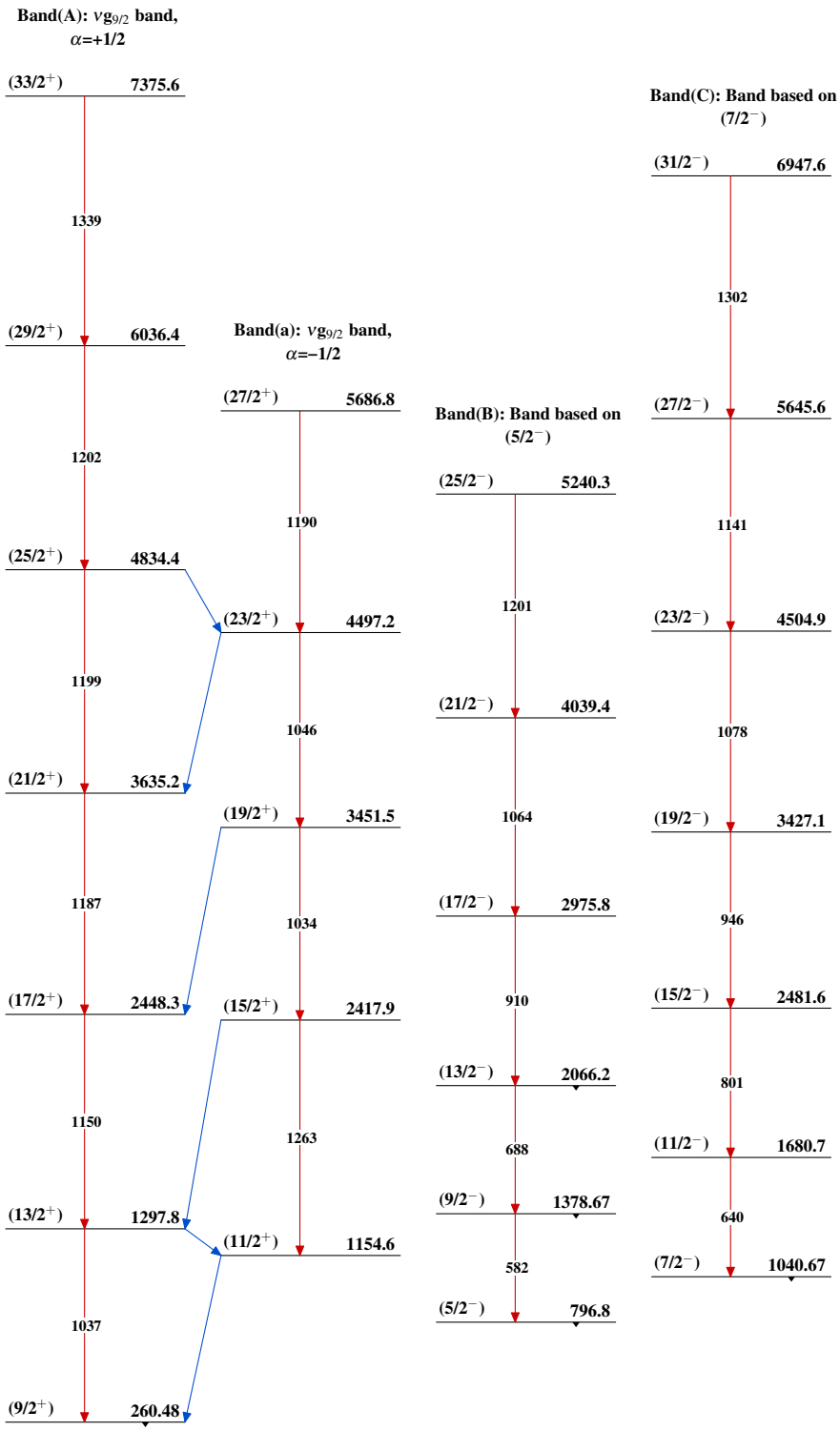
Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{71}_{34}Se_{37}$

Adopted Levels, Gammas



$^{71}_{34}Se_{37}$