^{69}Ga(n,n′γ) 1969Ve03,1979Ka29,1977SmZI

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	C. D. Nesaraja	NDS 115, 1 (2014)	31-Jul-2013

Target $J^\pi=3/2^-$.

1985KoZK: fast neutrons; measured $T_{1/2}$ from DSAM.

1979Ka29: reactor fast neutron; measured Eγ, Iγ, σ(E(n)), γ(θ), Hauser-Feshbach analysis.

1977SmZI: reactor fast neutrons; measured Eγ, Iγ.

1969Ve03: E(n)=0.4-2.5 MeV; measured Eγ, Iγ, σ(E(n)), γ(θ), Hauser-Feshbach analysis.

^{69}Ga Levels

E(level)†	Jπ‡	$T_{1/2}$#	Comments
0	$3/2^-$		
318.73 *3*	$1/2^-$		Jπ: 1/2 from γ(θ) (1979Ka29,1969Ve03).
574.29 *3*	$5/2^-$		Jπ: 5/2 from γ(θ) (1979Ka29,1969Ve03).
872.20 *3*	$3/2^-$		Jπ: 3/2 from γ(θ) (1979Ka29,1969Ve03).
1028.60 *5*	$1/2^-$		Jπ: 1/2 from yield (1979Ka29).
1107.08 *4*	$5/2^-$	0.15 ps *+17−6*	Jπ: 3/2 or 5/2 from γ(θ); yield favors 5/2 (1979Ka29).
1336.72 *4*	$7/2^-$	0.33 ps *+55−13*	Jπ: 7/2 from γ(θ) (1979Ka29,1969Ve03).
1488.30 *4*	$7/2^-$		Jπ: 7/2 from γ(θ) (1979Ka29).
1525.80 *4*	$3/2^-$	>0.28 ps	Jπ: $3/2^{(-)}$ from γ(θ) and yield (1979Ka29).
1723.75 *5*	$5/2^-$	0.15 ps *+12−6*	Jπ: 5/2 from γ(θ) of 1723γ (1979Ka29).
1765.11 *7*	$9/2^-$	0.38 ps *+69−19*	Jπ: 9/2 from γ(θ) and yield of 1191γ (1979Ka29).
1891.71 *7*	$3/2^-$	0.020 ps *10*	Jπ: 3/2 from γ(θ); yield do not exclude 1/2 (1979Ka29).
1924.29 *5*	$7/2^-$		Jπ: 7/2 from γ(θ) (1979Ka29).
1972.47 *6*	$9/2^{(+)}$		Jπ: 9/2 from γ(θ) (1979Ka29).
1973.10 *8*	$(1/2)^-$		
2007.76 *7*	$3/2^{(-)},5/2^{(-)}$	0.20 ps *+11−6*	Jπ: 3/2 or 5/2 from γ(θ).
2024.01 *8*	$5/2^-$		Jπ: 5/2 from γ(θ) of 2024γ (1979Ka29).
2045.46 *6*	$5/2^-$	0.029 ps *12*	
2251.15 *9*	$(1/2,3/2)^-$	0.033 ps *15*	Jπ: 1/2 suggested from isotropic γ(θ) of 2251γ and yield (1979Ka29).
2423.42 *7*			
2717.89 *8*	$13/2^{(+)}$		

† From least-squares fit to Eγ data of 1977SmZI.

‡ From Adopted Levels, supporting arguments from this data set are indicated.

From DSAM (1985KoZK).

^{69}Ga(n,n′γ) 1969Ve03,1979Ka29,1977SmZI (continued)

γ(^{69}Ga)

E_γ ‡	I_γ #	E_i(level)	J_i^π	E_f	J_f^π	Mult. @	δ &	α †	Comments
234.90 *6*	0.70 *10*	1107.08	5/2−	872.20	3/2−				
318.80 *5*	66 *4*	318.73	1/2−	0	3/2−				
381.31 *6*	1.9 *2*	1488.30	7/2−	1107.08	5/2−				
418.51 *6*	2.5 *3*	1525.80	3/2−	1107.08	5/2−				
484.03 *9*	1.00 *12*	1972.47	9/2(+)	1488.30	7/2−				
532.60 *15*	0.33 *9*	1107.08	5/2−	574.29	5/2−				
553.45 *5*	2.5 *3*	872.20	3/2−	318.73	1/2−	(M1(+E2))	0.00 *3*	0.000989 *14*	α=0.000989 *14*; α(K)=0.000886 *13*; α(L)=9.00×10^{-5} *13*; α(M)=1.317×10^{-5} *19*; α(N+..)=7.13×10^{-7} α(N)=7.13×10^{-7} *10*
574.31 *5*	100	574.29	5/2−	0	3/2−	(M1+E2)	−0.05 *2*	0.000912 *13*	α=0.000912 *13*; α(K)=0.000817 *12*; α(L)=8.29×10^{-5} *12*; α(M)=1.213×10^{-5} *17*; α(N+..)=6.57×10^{-7} α(N)=6.57×10^{-7} *10* δ: −0.03≥δ≥−0.1 or −1.5≥δ≥−3.5 (1969Ve03).
587.56 *6*	1.06 *9*	1924.29	7/2−	1336.72	7/2−				
616.42 *9*	0.89 *11*	1488.30	7/2−	872.20	3/2−				
635.80 *5*	4.2 *3*	1972.47	9/2(+)	1336.72	7/2−	(E1)		0.000363 *5*	α=0.000363 *5*; α(K)=0.000325 *5*; α(L)=3.27×10^{-5} *5*; α(M)=4.78×10^{-6} *7*; α(N+..)=2.57×10^{-7} *4* α(N)=2.57×10^{-7} *4* δ: δ(Q/D)=−0.01 *2*.
709.84 *5*	7.5 *4*	1028.60	1/2−	318.73	1/2−				
745.41 *6*	1.08 *9*	2717.89	13/2(+)	1972.47	9/2(+)				
762.47 *6*	2.3 *3*	1336.72	7/2−	574.29	5/2−				
788.18 *10*	0.82 *14*	1107.08	5/2−	318.73	1/2−				
851.31 *9*	0.30 *8*	1723.75	5/2−	872.20	3/2−				
872.24 *5*	43 *3*	872.20	3/2−	0	3/2−	(M1(+E2))	−0.09 *2*	0.000370 *6*	α=0.000370 *6*; α(K)=0.000332 *5*; α(L)=3.35×10^{-5} *5*; α(M)=4.90×10^{-6} *7*; α(N+..)=2.66×10^{-7} *4* α(N)=2.66×10^{-7} *4*
897.64 *19*	0.28 *9*	2423.42		1525.80	3/2−				
913.90 *6*	8.3 *7*	1488.30	7/2−	574.29	5/2−	(M1+E2)	−3.5 *5*	0.000397 *6*	α=0.000397 *6*; α(K)=0.000355 *6*; α(L)=3.61×10^{-5} *6*; α(M)=5.27×10^{-6} *8*; α(N+..)=2.83×10^{-7} *5* α(N)=2.83×10^{-7} *5*
935.31 *10*	0.64 *10*	2423.42		1488.30	7/2−				
951.54 *9*	0.41 *8*	1525.80	3/2−	574.29	5/2−				
x1004.49 *8*	0.88 *8*								
1028.63 *6*	4.6 *3*	1028.60	1/2−	0	3/2−				
1052.11 *6*	2.2 *2*	1924.29	7/2−	872.20	3/2−	(E2)		0.000287 *4*	α=0.000287 *4*; α(K)=0.000257 *4*; α(L)=2.60×10^{-5} *4*; α(M)=3.80×10^{-6} *6*; α(N+..)=2.04×10^{-7} *3* α(N)=2.04×10^{-7} *3*
x1085.12 *17*	0.21 *6*								
x1091.95 *8*	0.71 *8*								
1107.01 *6*	40 *3*	1107.08	5/2−	0	3/2−	(M1+E2)	+0.34 *4*	0.000231 *4*	α=0.000231 *4*; α(K)=0.000206 *3*; α(L)=2.07×10^{-5} *3*;

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^{69}Ga(n,n′γ) 1969Ve03,1979Ka29,1977SmZI (continued)

γ(^{69}Ga) (continued)

E_γ[‡]	I_γ[#]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[@]	δ[&]	α[†]	Comments
									α(M)=3.03×10^{-6} *5*; α(N+..)=8.92×10^{-7} *15* α(N)=1.646×10^{-7} *24*; α(IPF)=7.28×10^{-7} *13*
1135.64 *8*	0.94 *10*	2007.76	3/2$^{(-)}$,5/2$^{(-)}$	872.20	3/2$^-$				
1149.46 *7*	2.3 *2*	1723.75	5/2$^-$	574.29	5/2$^-$	(M1+E2)	−0.6 *1*	0.000219 *4*	α=0.000219 *4*; α(K)=0.000194 *3*; α(L)=1.96×10^{-5} *3*; α(M)=2.86×10^{-6} *5*; α(N+..)=2.61×10^{-6} *7* α(N)=1.551×10^{-7} *25*; α(IPF)=2.45×10^{-6} *7*
1173.09 *9*	0.82 *11*	2045.46	5/2$^-$	872.20	3/2$^-$				
[x]1180.45 *18*	0.20 *6*								
1190.80 *6*	7.2 *6*	1765.11	9/2$^-$	574.29	5/2$^-$	(E2)		0.000224 *4*	α=0.000224 *4*; α(K)=0.000194 *3*; α(L)=1.96×10^{-5} *3*; α(M)=2.86×10^{-6} *4*; α(N+..)=7.51×10^{-6} *11* α(N)=1.544×10^{-7} *22*; α(IPF)=7.36×10^{-6} *11* δ: δ(O/Q)=0.00 *5*.
1207.21 *6*	6.1 *4*	1525.80	3/2$^-$	318.73	1/2$^-$	(M1+E2)	+0.1 *2*	0.000198 *4*	α=0.000198 *4*; α(K)=0.000171 *3*; α(L)=1.72×10^{-5} *3*; α(M)=2.52×10^{-6} *4*; α(N+..)=7.20×10^{-6} *22* α(N)=1.369×10^{-7} *22*; α(IPF)=7.07×10^{-6} *22*
[x]1212.86 *6*	3.4 *4*								
[x]1235.98 *7*	1.2 *2*								
[x]1244.34 *11*	0.75 *10*								
[x]1321.92 *13*	0.37 *7*								
1336.72 *6*	22 *2*	1336.72	7/2$^-$	0	3/2$^-$	(E2)		0.000205 *3*	α=0.000205 *3*; α(K)=0.0001511 *22*; α(L)=1.522×10^{-5} *22*; α(M)=2.22×10^{-6} *4*; α(N+..)=3.70×10^{-5} *6* α(N)=1.202×10^{-7} *17*; α(IPF)=3.69×10^{-5} *6* δ: δ(O/Q)=+0.02 *3*.
1350.05 *7*	2.3 *2*	1924.29	7/2$^-$	574.29	5/2$^-$	(M1+E2)	−2.7 *3*	0.000203 *3*	α=0.000203 *3*; α(K)=0.0001467 *21*; α(L)=1.477×10^{-5} *21*; α(M)=2.16×10^{-6} *3*; α(N+..)=3.91×10^{-5} *7* α(N)=1.168×10^{-7} *17*; α(IPF)=3.89×10^{-5} *6*
1398.08 *15*	0.30 *7*	1972.47	9/2$^{(+)}$	574.29	5/2$^-$				
1405.12 *8*	1.2 *2*	1723.75	5/2$^-$	318.73	1/2$^-$				
1449.50 *12*	0.40 *6*	2024.01	5/2$^-$	574.29	5/2$^-$				
[x]1454.65 *9*	0.61 *8*								
1471.43 *9*	0.88 *10*	2045.46	5/2$^-$	574.29	5/2$^-$				
1488.13 *7*	6.8 *5*	1488.30	7/2$^-$	0	3/2$^-$	(E2)		0.000217 *3*	α=0.000217 *3*; α(K)=0.0001210 *17*; α(L)=1.217×10^{-5} *17*; α(M)=1.779×10^{-6} *25* α(N)=9.63×10^{-8} *14*; α(IPF)=8.19×10^{-5} *12* δ: δ(O/Q)=0.00 *2*. I_γ: From adopted branching from the 1488 level, one expects Iγ≈11.
[x]1507.8 *3*	0.14 *7*								
1525.83 *7*	3.0 *2*	1525.80	3/2$^-$	0	3/2$^-$				
1572.99 *8*	1.2 *2*	1891.71	3/2$^-$	318.73	1/2$^-$				
1654.17[a] *11*	0.73 *9*	1973.10	(1/2)$^-$	318.73	1/2$^-$				
1723.79 *8*	3.5 *2*	1723.75	5/2$^-$	0	3/2$^-$	(M1+E2)	−0.75	0.000257 *4*	α=0.000257 *4*; α(K)=8.82×10^{-5} *13*; α(L)=8.84×10^{-6} *13*;

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^{69}Ga(n,n′γ) 1969Ve03,1979Ka29,1977SmZI (continued)

γ(^{69}Ga) (continued)

E_γ[‡]	I_γ[#]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[@]	δ[&]	α[†]	Comments
									α(M)=1.292×10^{-6} *18*; α(N+..)=0.0001582
									α(N)=7.02×10^{-8} *10*; α(IPF)=0.0001582 *23*
[x]1744.9 *2*	0.23 *7*								
1849.00 *11*	0.71 *8*	2423.42		574.29	5/2$^-$				
[x]1875.5 *2*	0.15 *6*								
[x]1884.94 *11*	0.75 *7*								
1891.62 *10*	1.44 *12*	1891.71	3/2$^-$	0	3/2$^-$	(M1+E2)	−0.15 *5*	0.000295 *5*	α=0.000295 *5*; α(K)=7.33×10^{-5} *11*; α(L)=7.34×10^{-6} *11*;
									α(M)=1.073×10^{-6} *15*; α(N+..)=0.000214 *3*
									α(N)=5.85×10^{-8} *9*; α(IPF)=0.000213 *3*
[x]1900.83 *11*	0.68 *7*								
1923.6 *2*	0.40 *12*	1924.29	7/2$^-$	0	3/2$^-$				
1932.46 *11*	0.66 *8*	2251.15	(1/2,3/2)$^-$	318.73	1/2$^-$				
1973.24[a] *11*	0.88 *8*	1973.10	(1/2)$^-$	0	3/2$^-$				E_γ: assigned to the 1972.62 level by the authors; ^{68}Zn(p,γ) data indicate this deexcites the 1973.24 level.
2007.59 *10*	4.0 *3*	2007.76	3/2$^{(-)}$,5/2$^{(-)}$	0	3/2$^-$	(M1+E2)		0.00036 *3*	α=0.00036 *3*; α(K)=6.70×10^{-5} *15*; α(L)=6.70×10^{-6} *15*;
									α(M)=9.80×10^{-7} *22*; α(N+..)=0.00029 *3*
									α(N)=5.33×10^{-8} *11*; α(IPF)=0.00029 *3*
									δ: −1.25 *3* for 3/2 to 3/2 transition; 0.00 *5* for 5/2 to 3/2 transition.
2024.12 *10*	2.7 *3*	2024.01	5/2$^-$	0	3/2$^-$	(M1+E2)	+0.15 *5*	0.000343 *5*	α=0.000343 *5*; α(K)=6.50×10^{-5} *10*; α(L)=6.50×10^{-6} *10*;
									α(M)=9.50×10^{-7} *14*; α(N+..)=0.000271 *4*
									α(N)=5.17×10^{-8} *8*; α(IPF)=0.000271 *4*
[x]2040.0 *3*	0.84 *10*								
2045.20 *12*	0.91 *8*	2045.46	5/2$^-$	0	3/2$^-$				
[x]2121.99 *12*	0.84 *8*								
2251.02 *13*	1.07 *9*	2251.15	(1/2,3/2)$^-$	0	3/2$^-$				γ(θ) isotropic (1979Ka29).
[x]2327.0 *4*	0.18 *6*								
[x]2339.7 *6*	0.12 *7*								
[x]2353.19 *15*	0.55 *8*								
2422.9 *2*	0.43 *9*	2423.42		0	3/2$^-$				
[x]2459.6 *4*	0.20 *8*								
[x]2486.14 *10*	1.09 *9*								
[x]2530.17 *15*	0.75 *10*								
[x]2569.7 *2*	0.57 *11*								
[x]2722.2 *3*	0.34 *9*								
[x]2744.5 *3*	0.27 *8*								
[x]2763.4 *2*	0.27 *6*								
[x]2926.9 *2*	0.47 *9*								

[†] Additional information 1.

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^{69}Ga(n,n′γ) 1969Ve03,1979Ka29,1977SmZI (continued)

γ(^{69}Ga) (continued)

‡ From 1977SmZI.
# From 1977SmZI with I(574γ)=100.
@ Based on γ(θ) of 1979Ka29 and the J^{π} of initial and final levels.
& As given by 1979Ka29, from 4-point γ(θ).
a The 1654.17 γ is unplaced by 1977SmZI and the 1973.24 is placed from the 1972.47 level. In (p,γ), transitions of these energies are placed from a 1973 level, with branching reasonably consistent in the two works.
x γ ray not placed in level scheme.

$^{69}_{31}Ga_{38}$-5

^{69}Ga(n,n′γ) 1969Ve03,1979Ka29,1977SmZI

Level Scheme

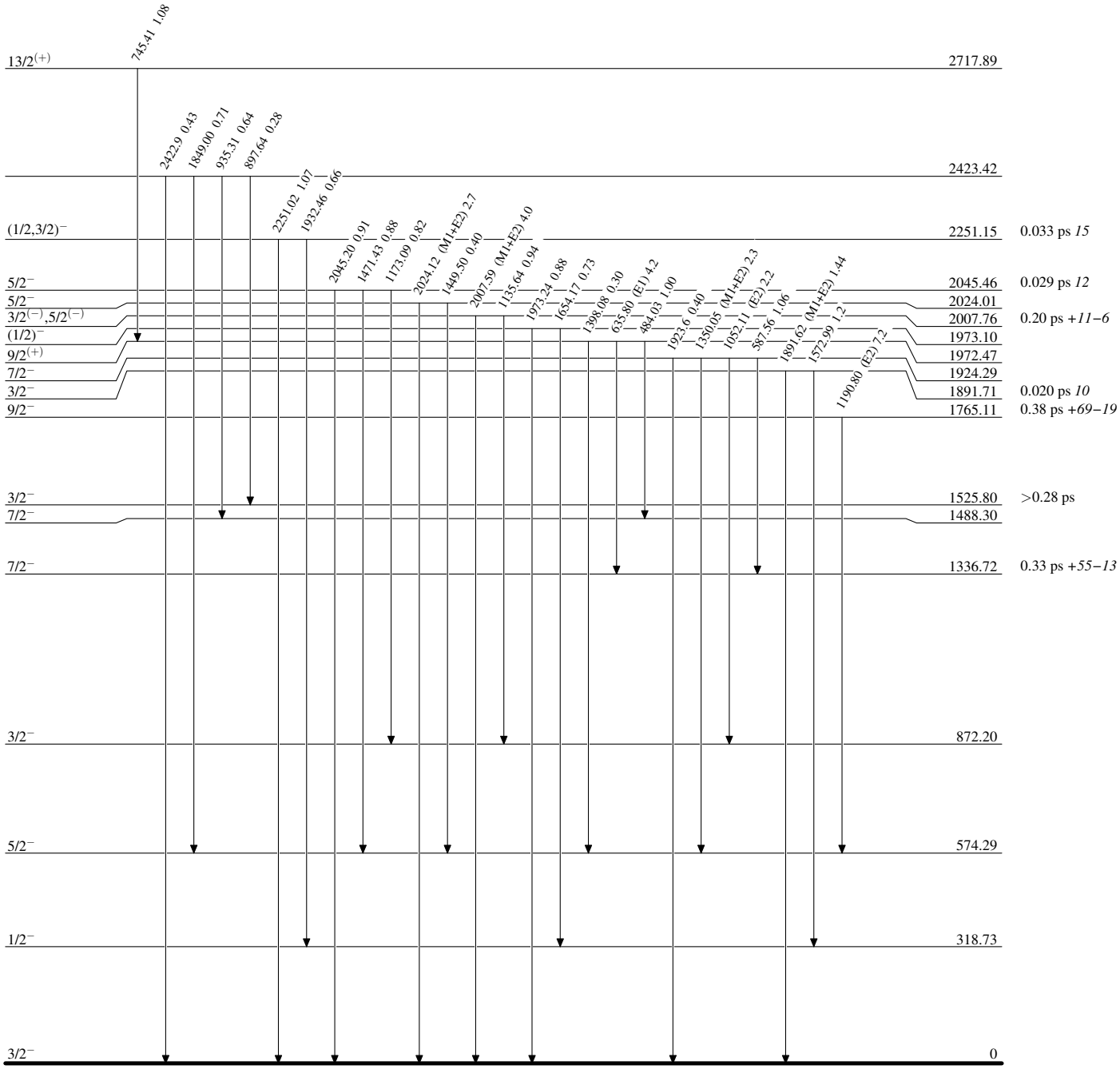
Intensities: Type not specified

Legend

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

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

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



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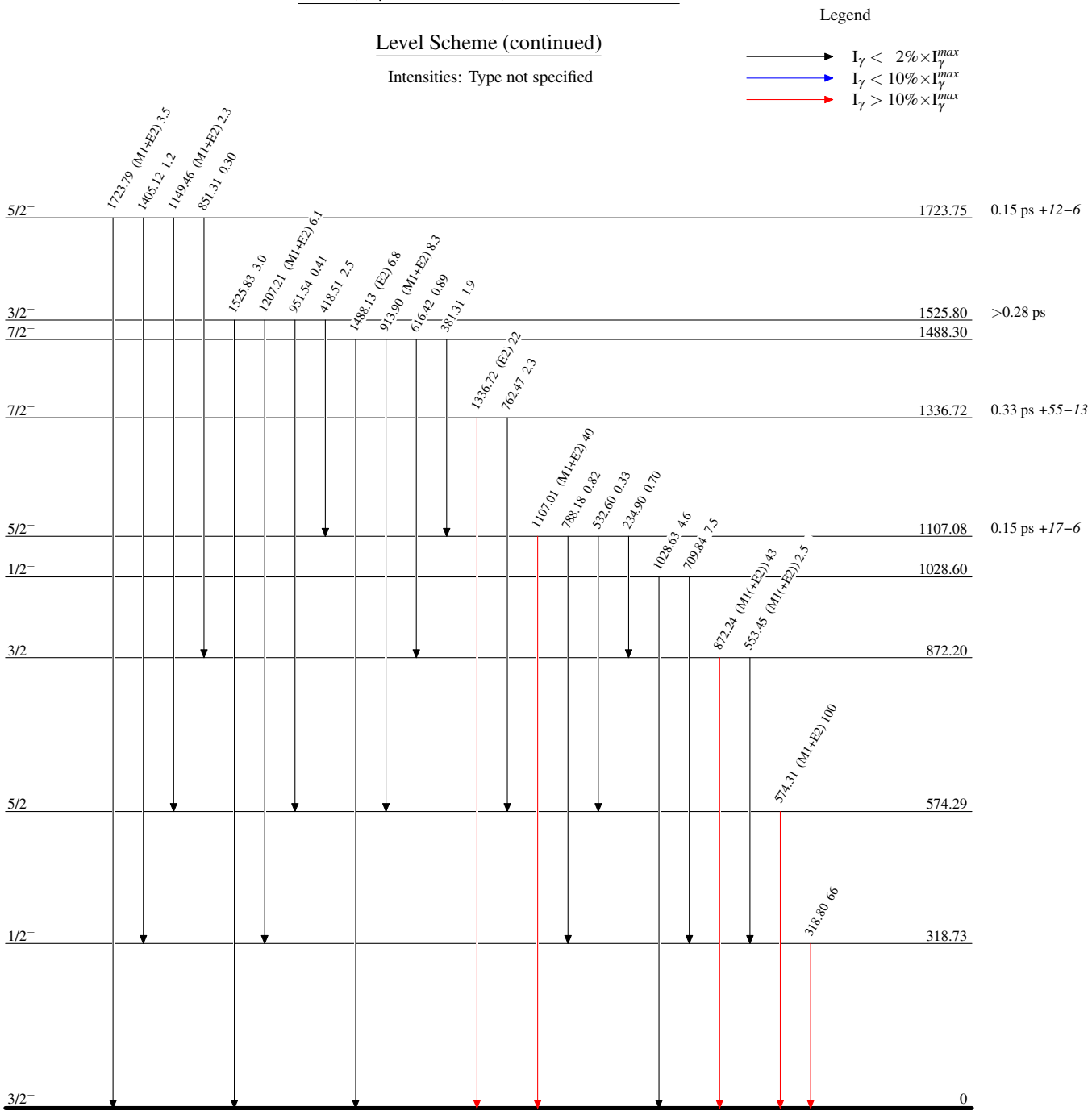
^{69}Ga(n,n′γ) 1969Ve03,1979Ka29,1977SmZI

Level Scheme (continued)

Intensities: Type not specified



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