^{40}Ca(^{40}Ca,α3pγ) 2000Pl08,1990He08,1987He27

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 158, 1 (2019)	16-May-2019

Includes ^{40}Ca(^{36}Ar,3pγ); ^{58}Ni(^{24}Mg,p2$\alpha\gamma$); ^{54}Fe(^{28}Si,4n5pγ).

2000Pl08: ^{40}Ca(^{40}Ca,α3pγ), E=185 MeV. Measured Eγ, Iγ, and $\gamma\gamma$-coin, $\gamma\gamma(\theta)$(DCO) using EUROBALL III array consisting of 15 cluster and 26 clover detectors. In addition, charged particles were detected with the Silicon Sphere array, consisting of 40 Si ΔE-E telescopes. The DCO ratios are given in Fig. 3 of 2000Pl08. Deduced four band structures and configurations, and interpreted in terms of configuration-dependent cranked Nilsson-Strutinsky model. Experiments were performed at Legnaro accelerator facility.

1990He08: ^{58}Ni(^{24}Mg,p2$\alpha\gamma$), E=110 MeV, $\gamma\gamma$-coin measurements; ^{40}Ca(^{36}Ar,3pγ), E=130 MeV, ce measurements. Deduced three bands up to (45/2), and multipolarities from ce and γ data for eight low-energy transitions. Experiments were performed at Hahn-Meitner Institut, Berlin accelerator facility.

1987He27: ^{40}Ca(^{40}Ca,α3pγ), E=155 MeV, measured $\gamma\gamma$-coin, (particle)γ, and (particle)$\gamma\gamma$ coin; ^{40}Ca(^{36}Ar,3pγ), E=105,125 MeV. Measured $\gamma(\theta)$, $\gamma\gamma$-coin, level lifetimes by RDM and DSAM, isomer half-life by γ(t). Deduced three bands up to 37/2. Experiments were performed at Daresbury Nuclear Structure Laboratory, and Hahn-Meitner Institut, Berlin accelerator facilities.

Others:

1990Sa04: ^{40}Ca(^{35}Cl,2pγ), E=95 MeV; observed 11 γ rays belonging to ^{73}Br, while the main experiment was for ^{73}Kr. Experiments carried out at Rochester and ORNL accelerator facilities.

1985Wo12: ^{40}Ca(^{36}Ar,3pγ), E=105 MeV, nanosecond pulsed beam, neutron multiplicity filter, $\gamma\gamma$-coin, level lifetimes by RDM at 115 MeV, isomer lifetime by γ(t). Deduced two bands up to 33/2. Experiments were performed at Hahn-Meitner Institut, Berlin accelerator facility.

1985We10: ^{54}Fe(^{28}Si,4n5pγ), E=128 MeV, two γ cascades by (recoil mass)γ-coin and $\gamma\gamma$-coin. Observed 14 γ rays and two bands up to 33/2.

1990He08, 1987He27 and 1985Wo12 are from the same laboratories. 1990Sa04 and 1985We10 are from the same group.

See 2000Pl08 for proposed configurations for bands based on protons in $p_{3/2}$ and $f_{5/2}$ orbits and neutrons in $g_{9/2}$ orbit.

The level scheme is taken from 1990He08 and 2000Pl08.

^{73}Br Levels

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$	Comments
0.0	1/2$^-$		J$^\pi$: from Adopted Levels.
26.88[c] *10*	5/2$^-$		
177.99[b] *18*	3/2$^-$	0.35[@] ns *15*	T$_{1/2}$: other: 0.43 ns *8* (1985Wo12, same group as 1987He27).
240.48 *18*	(3/2,5/2)$^-$	35.0 ns *14*	g=1.31 *9* (1987He27) T$_{1/2}$: γ(t) in (^{36}Ar,3pγ) (1987He27, earlier value was 37 ns *6* in 1985Wo12). g: from Larmor precession.
286.08[a] *20*	(5/2)$^+$	<0.49[@] ps	J$^\pi$: band assignment in analogy to a similar band in ^{75}Br.
473.58[a] *22*	9/2$^+$	1.11[@] ns *21*	T$_{1/2}$: other: 1.11 ns *21* (1985Wo12, same group as 1987He27).
481.38 *15*	(5/2$^-$)		
681.19[b] *19*	7/2$^-$	15.2[@] ps *21*	T$_{1/2}$: other: 15.5 ps *21* (1985Wo12, same group as 1987He27).
943.18[c] *14*	(9/2$^-$)	2.77[@] ps *14*	J$^\pi$: no supporting data are quoted by 1990He08 or 1987He27.
1056.68[a] *25*	13/2$^+$	3.33[@] ps *28*	T$_{1/2}$: other: 3.33 ps *35* (1985Wo12, same group as 1987He27).
1255.09[b] *21*	11/2$^-$	2.98[@] ps *21*	T$_{1/2}$: other: 2.98 ns *35* (1985Wo12, same group as 1987He27).
1662.19[c] *17*	(13/2$^-$)	0.97[@] ps *14*	
1861.1[a] *4*	17/2$^+$	1.04 ps *21*	T$_{1/2}$: average of 1.5 *4* (RDM), 0.97 *21* (DSAM), and 0.9 *2* (DSAM) (1987He27). Other: <1.2 ps (1985Wo12, same group as 1987He27).
1989.60[b] *23*	15/2$^-$	0.90[@] ps *17*	T$_{1/2}$: other: <1.7 ps (1985Wo12, same group as 1987He27).
2512.39[c] *20*	(17/2$^-$)	0.69 ps *17*	T$_{1/2}$: average of 0.67 *17* (RDM) and 0.73 *17* (DSAM).
2856.3[a] *4*	21/2$^+$	0.43 ps *6*	T$_{1/2}$: average of 0.41 *6* (DSAM) and 0.45 *6* (DSAM).
2874.2[b] *3*	(19/2$^-$)	0.59[&] ps *7*	

Continued on next page (footnotes at end of table)

^{40}Ca(^{40}Ca,α3pγ) 2000Pl08,1990He08,1987He27 (continued)

^{73}Br Levels (continued)

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$	E(level)[†]	J$^\pi$[‡]
3464.9[c] *4*	$(21/2^-)$	0.38[&] ps *7*	11583[#e] *5*	$(43/2^-)$
3909.9[b] *4*	$(23/2^-)$	0.26[&] ps *5*	11958[c] *5*	$(45/2^-)$
3967.3[#] *21*	$(25/2^+)$		12236[a] *5*	$(45/2^+)$
4020.4[a] *18*	$(25/2^+)$	0.14[&] ps *5*	12668[d] *5*	$(45/2^+)$
4067.2[#d] *18*	$(25/2^+)$		13286[b] *5*	$(47/2^-)$
4536.9[c] *7*	$(25/2^-)$	0.28[&] ps *6*	13999[e] *5*	$(47/2^-)$
5090.9[b] *11*	$(27/2^-)$	0.12[&] ps *5*	14019[c] *5*	$(49/2^-)$
5334.7[a] *24*	$(29/2^+)$	0.11[&] ps *5*	14336[a] *5*	$(49/2^+)$
5641.2[#d] *20*	$(29/2^+)$		15532[b] *5*	$(51/2^-)$
5752.9[c] *21*	$(29/2^-)$		16373[c] *6*	$(53/2^-)$
6402.9[b] *23*	$(31/2^-)$		16632[a] *6*	$(53/2^+)$
6801[a] *3*	$(33/2^+)$		16660 *6*	$(53/2^+)$
7100[c] *3*	$(33/2^-)$		18116[b] *6*	$(55/2^-)$
7249.9[#d] *24*	$(33/2^+)$		18317 *6*	$(55/2^-)$
7874[b] *3*	$(35/2^-)$		19094[c] *6*	$(57/2^-)$
8452[a] *4*	$(37/2^+)$		19110 *6*	$(57/2^-)$
8563[c] *4*	$(37/2^-)$		19163[a] *6*	$(57/2^+)$
9007[#d] *4*	$(37/2^+)$		20679[b] *6*	$(59/2^-)$
9511[b] *4*	$(39/2^-)$		21972[a] *6*	$(61/2^+)$
9621[#e] *4*	$(39/2^-)$		22272[c] *6*	$(61/2^-)$
10156[c] *4*	$(41/2^-)$		23702[b] *6*	$(63/2^-)$
10277[a] *5*	$(41/2^+)$		25179[a] *7*	$(65/2^+)$
10793[#d] *4*	$(41/2^+)$		25968[c] *6*	$(65/2^-)$
11291[b] *5*	$(43/2^-)$			

[†] From least-squares fit to Eγ data, assuming ΔEγ=2 keV, when not stated.
[‡] From J^π of bandhead and band assignment which is based on the dependence of Eγ and T$_{1/2}$ on J, and the stretched E2 character of the inband transitions (1987He27,1990He08), except as noted otherwise.
[#] From 2000Pl08.
[@] From recoil-distance method (RDM) (1987He27).
[&] From DSAM (1987He27).
[a] Band(A): Band based on $(5/2)^+$,α=+1/2. Proposed configuration=$\pi[(\mathrm{pf})^4\mathrm{g}^3_{9/2}] \otimes \nu[(\mathrm{pf})^6\mathrm{g}^4_{9/2}]$ (2000Pl08), where p and f are p$_{3/2}$ and f$_{5/2}$ orbitals, respectively.
[b] Band(B): Band based on $3/2^-$,α=−1/2. Proposed configuration=$\pi[(\mathrm{pf})^5\mathrm{g}^2_{9/2}] \otimes \nu[(\mathrm{pf})^6\mathrm{g}^4_{9/2}]$ (2000Pl08), where p and f are p$_{3/2}$ and f$_{5/2}$ orbitals, respectively. Based on theoretical calculations, 2000Pl08 propose that this band, with $63/2^-$ for the highest level, has reached termination.
[c] Band(b): Band based on $5/2^-$,α=+1/2. Proposed configuration=$\pi[(\mathrm{pf})^5\mathrm{g}^2_{9/2}] \otimes \nu[(\mathrm{pf})^6\mathrm{g}^4_{9/2}]$ (2000Pl08), where p and f are p$_{3/2}$ and f$_{5/2}$ orbitals, respectively.
[d] Band(C): Band based on $(25/2^+)$,α=+1/2.
[e] Band(D): Side band based on $(39/2^-)$.

^{40}Ca(^{40}Ca,α3pγ) 2000Pl08,1990He08,1987He27 (continued)

γ(^{73}Br)

Gamma-ray intensity data are available from 1987He27 only.
A_2 and A_4 coefficients are from 1987He27; α(K)exp values are from 1990He08.
DCO ratios were measured by 2000Pl08, but shown only in a plot (Authors′ Fig. 3). With gates on stretched quadrupoles, expected DCO=1.0 for stretched quadrupole, and 0.6 for stretched dipole.
α(K)exp from 1990He08, determined from Ice/Iγ(90°), assuming the 188 keV transition is pure E2 with α(K)=0.075 *6*.

E_γ[†]	I_γ[‡]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	δ	Comments
26.9 *1*		26.88	5/2⁻	0.0	1/2⁻			E_γ: from Adopted Gammas. Other: 26.8 from K-conversion peak observed at 13.3; with I(ce)/I(ceK)(188γ)=0.42 *13* (1990He08).
45.6 *3*	28 *9*	286.08	(5/2)⁺	240.48	(3/2,5/2)⁻	E1		α(K)exp=0.84 *8* Mult.: dipole from α(K)exp; M1 excluded by ΔJ^π.
62.5 *3*	44 *10*	240.48	(3/2,5/2)⁻	177.99	3/2⁻	M1		α(K)exp=0.36 *6* Mult.: from α(K)exp, same efficiency correction factors used for this and the 214 ce lines (1990He08).
108.2[@]	6 *3*	286.08	(5/2)⁺	177.99	3/2⁻	E1		α(K)exp=0.058 *7*
151.1[@]	18 *3*	177.99	3/2⁻	26.88	5/2⁻			A_2=−0.15 *6*; A_4=+0.06 *6*
177.8 *3*	74 *3*	177.99	3/2⁻	0.0	1/2⁻	M1+E2	0.39 *12*	A_2=−0.132 *12*; A_4=−0.019 *15* α(K)exp=0.031 *5* δ: from α(K)exp, deduced by evaluators using the BrIccMixing code.
187.5 *1*	100	473.58	9/2⁺	286.08	(5/2)⁺	E2		A_2=+0.184 *20*; A_4=−0.065 *23* α(K)exp=0.075 *6*
213.6 *2*	41 *3*	240.48	(3/2,5/2)⁻	26.88	5/2⁻	E2		α(K)exp=0.050 *7* A_2=−0.054 *10*; A_4=−0.006 *12*
259.2 *2*	25 *2*	286.08	(5/2)⁺	26.88	5/2⁻	E1		A_2=+0.158 *15*; A_4=+0.004 *17* α(K)exp=0.0050 *4* I_γ: too high by a factor of ≈4, as compared to that in Adopted Gammas, where the value is from ^{73}Kr ε decay. ΔJ=0 (1987He27).
303.4 *4*		481.38	(5/2⁻)	177.99	3/2⁻			
454.5 *2*		481.38	(5/2⁻)	26.88	5/2⁻	D		DCO=1 (2000Pl08), interpreted by authors as ΔJ=0, dipole (M1) transition.
461.8 *1*		943.18	(9/2⁻)	481.38	(5/2⁻)	E2		Mult.: from DCO (2000Pl08), and RUL.
503.1 *2*	35 *5*	681.19	7/2⁻	177.99	3/2⁻	E2		A_2=+0.21 *5*; A_4=−0.05 *6*
ˣ526[a]								E_γ: a 526γ also belongs to ^{73}Kr.
573.9 *1*	38 *2*	1255.09	11/2⁻	681.19	7/2⁻	E2		A_2=+0.28 *4*; A_4=−0.09 *4*
583.1 *1*	79 *3*	1056.68	13/2⁺	473.58	9/2⁺	E2		A_2=+0.29 *4*; A_4=−0.08 *3*
ˣ593[a]								
654.4 *2*	15 *2*	681.19	7/2⁻	26.88	5/2⁻			Mult.: M1+E2 stated by 1990He08 without quoting any supporting data. E_γ: possibly a doublet.
719.0 *1*	28 *5*	1662.19	(13/2⁻)	943.18	(9/2⁻)	E2		A_2=+0.25 *7*; A_4=−0.08 *9*
734.5 *1*	26 *2*	1989.60	15/2⁻	1255.09	11/2⁻	E2		A_2=+0.267 *21*; A_4=−0.05 *3*
804.4 *2*	54 *3*	1861.1	17/2⁺	1056.68	13/2⁺	E2		A_2=+0.224 *24*; A_4=−0.076 *26*
ˣ812[a]								
850.2 *1*	16 *3*	2512.39	(17/2⁻)	1662.19	(13/2⁻)			
884.6 *1*	14 *1*	2874.2	(19/2⁻)	1989.60	15/2⁻			
916.3 *1*	26 *5*	943.18	(9/2⁻)	26.88	5/2⁻			Mult.: E2 stated by 1990He08 without quoting any supporting data.

Continued on next page (footnotes at end of table)

$^{40}Ca(^{40}Ca,\alpha 3p\gamma)$ 2000Pl08,1990He08,1987He27 (continued)

$\gamma(^{73}Br)$ (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	Comments
952.5 3		3464.9	(21/2−)	2512.39	(17/2−)		
995.2 2	18 2	2856.3	21/2+	1861.1	17/2+	E2	A_2=+0.243 15; A_4=−0.09 4
1035.7 3	5 2	3909.9	(23/2−)	2874.2	(19/2−)		
1072.0 5	<3	4536.9	(25/2−)	3464.9	(21/2−)		
1111[&]		3967.3	(25/2+)	2856.3	21/2+		
1165 2	10 2	4020.4	(25/2+)	2856.3	21/2+		
1181 1	<3	5090.9	(27/2−)	3909.9	(23/2−)		
1210[&]		4067.2	(25/2+)	2856.3	21/2+	Q[b]	
1216[&]	<3	5752.9	(29/2−)	4536.9	(25/2−)		
1312[@] 2	<3	6402.9	(31/2−)	5090.9	(27/2−)		
1315[&]	4 1	5334.7	(29/2+)	4020.4	(25/2+)		
1347[&]	<3	7100	(33/2−)	5752.9	(29/2−)		
1463[&]		8563	(37/2−)	7100	(33/2−)		
1466[&]	<3	6801	(33/2+)	5334.7	(29/2+)		
1471[&]		7874	(35/2−)	6402.9	(31/2−)	Q[b]	
1573[&]		5641.2	(29/2+)	4067.2	(25/2+)		
1593[&]		10156	(41/2−)	8563	(37/2−)	Q[b]	
1608[&]		7249.9	(33/2+)	5641.2	(29/2+)		
1621[&]		5641.2	(29/2+)	4020.4	(25/2+)		
1637[&]		9511	(39/2−)	7874	(35/2−)	Q[b]	
1651[&]		8452	(37/2+)	6801	(33/2+)	Q[b]	
1747[&]		9621	(39/2−)	7874	(35/2−)		
1757[&]		9007	(37/2+)	7249.9	(33/2+)		
1780[&]		11291	(43/2−)	9511	(39/2−)	Q[b]	
1786[&]		10793	(41/2+)	9007	(37/2+)		
1802[&]		11958	(45/2−)	10156	(41/2−)		
1825[&]		10277	(41/2+)	8452	(37/2+)		
1875		12668	(45/2+)	10793	(41/2+)		
1916[&]		7249.9	(33/2+)	5334.7	(29/2+)		
1959		12236	(45/2+)	10277	(41/2+)		
1962[&]		11583	(43/2−)	9621	(39/2−)		
1995		13286	(47/2−)	11291	(43/2−)		
2061		14019	(49/2−)	11958	(45/2−)		
2100		14336	(49/2+)	12236	(45/2+)		
2246		15532	(51/2−)	13286	(47/2−)		
2296		16632	(53/2+)	14336	(49/2+)		
2324		16660	(53/2+)	14336	(49/2+)		
2354		16373	(53/2−)	14019	(49/2−)		
2362		20679	(59/2−)	18317	(55/2−)		
2416		13999	(47/2−)	11583	(43/2−)		
2503		19163	(57/2+)	16660	(53/2+)		
2532		19163	(57/2+)	16632	(53/2+)		
2563		20679	(59/2−)	18116	(55/2−)		
2584		18116	(55/2−)	15532	(51/2−)		
2721		19094	(57/2−)	16373	(53/2−)		
2737		19110	(57/2−)	16373	(53/2−)		
2785		18317	(55/2−)	15532	(51/2−)		
2809		21972	(61/2+)	19163	(57/2+)		
3023		23702	(63/2−)	20679	(59/2−)		
3162		22272	(61/2−)	19110	(57/2−)		

Continued on next page (footnotes at end of table)

^{40}Ca(^{40}Ca,α3pγ) 2000Pl08,1990He08,1987He27 (continued)

γ(^{73}Br) (continued)

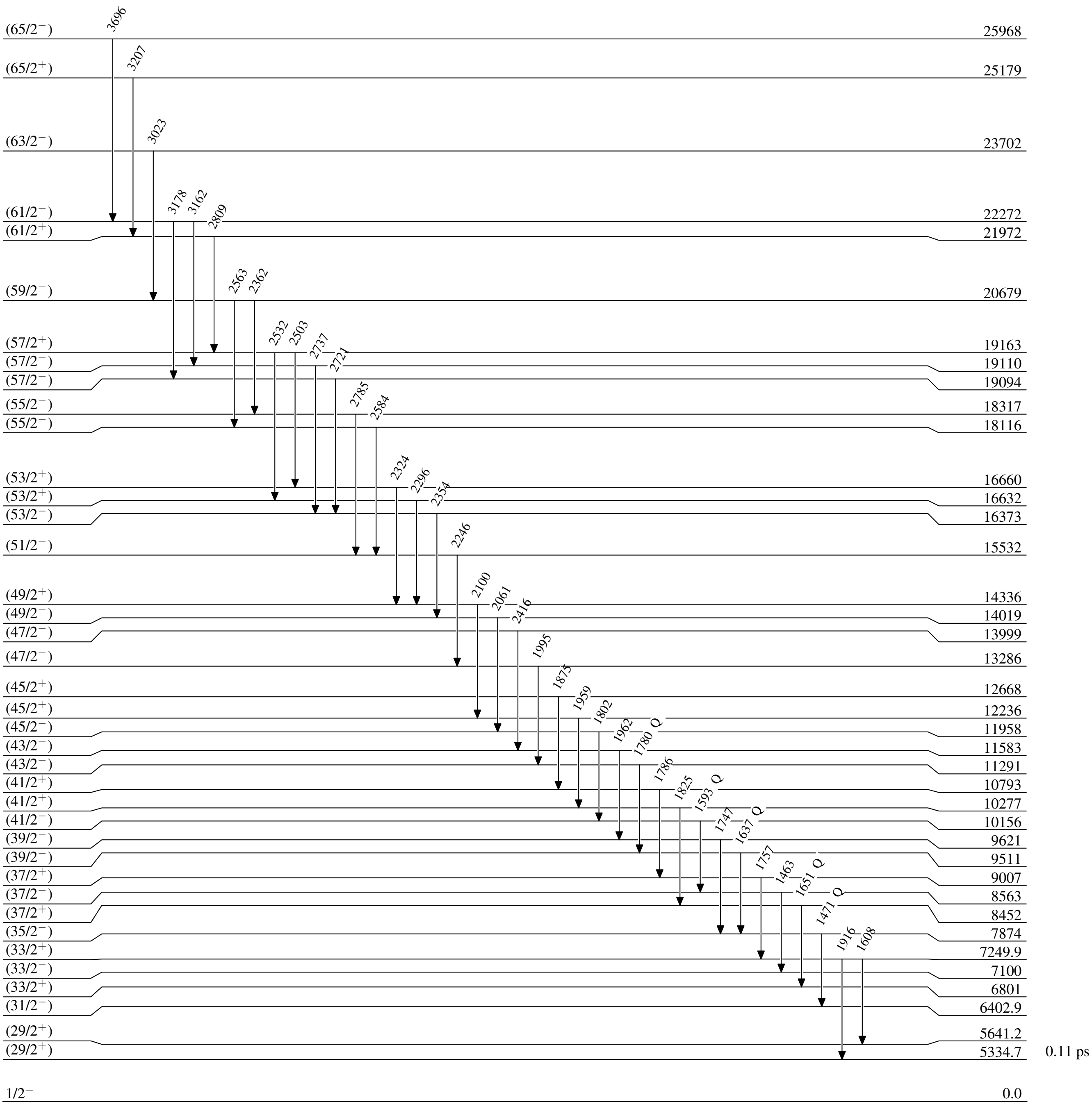
E_γ [†]	E_i(level)	J_i^π	E_f	J_f^π
3178	22272	(61/2$^-$)	19094	(57/2$^-$)
3207	25179	(65/2$^+$)	21972	(61/2$^+$)
3696	25968	(65/2$^-$)	22272	(61/2$^-$)

[†] From 1987He27 below 12000 excitation energy, unless stated otherwise. Eγ values for levels above 12000 are from 2000Pl08.
[‡] From ^{40}Ca(^{36}Ar,3pγ), E=105 MeV (1987He27).
[#] E2 from $\gamma(\theta)$ in 1987He27 and RUL, and ΔJ=2, Q from DCO data in 2000Pl08, except as noted.
[@] From 1990He08, uncertainties estimated by the evaluators.
[&] From 2000Pl08.
[a] Weak γ ray from 1990He08 observed in coin with 178γ and 188γ, but could not be placed in the level scheme.
[b] Stretched E2 assigned by 2000Pl08, but no data supporting this assignment are available.
[x] γ ray not placed in level scheme.

$^{40}Ca(^{40}Ca,\alpha 3p\gamma)$ 2000Pl08,1990He08,1987He27

Level Scheme

Intensities: Relative I_γ

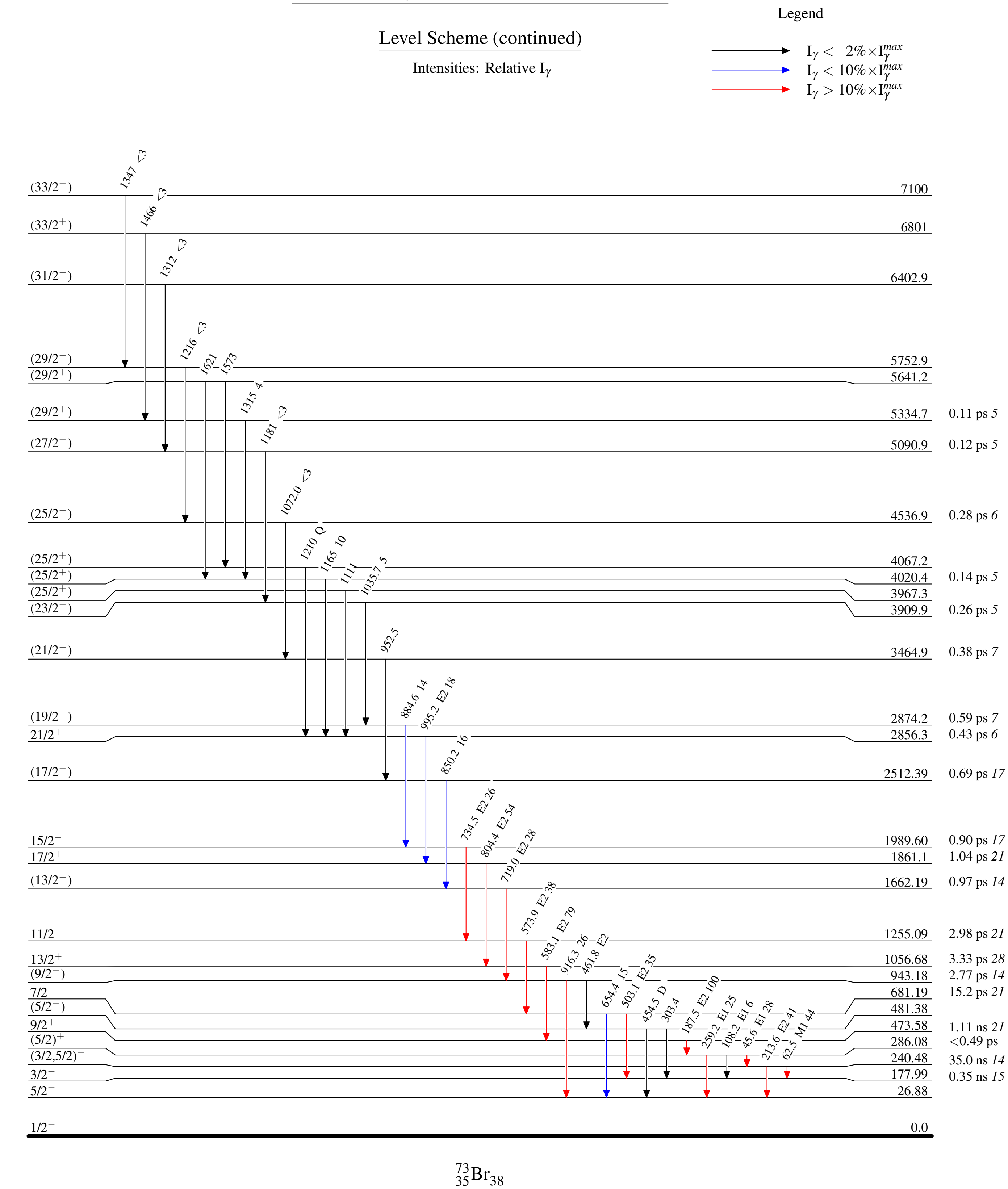


$^{73}_{35}Br_{38}$

$^{40}Ca(^{40}Ca,\alpha 3p\gamma)$ 2000Pl08,1990He08,1987He27

Level Scheme (continued)

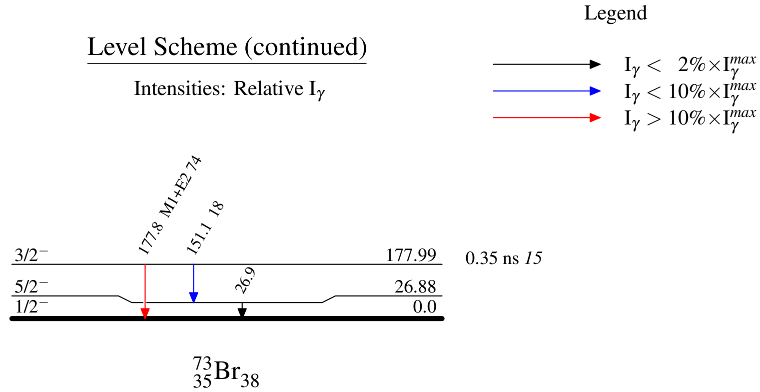
Intensities: Relative I_γ



^{40}Ca(^{40}Ca,α3pγ) 2000Pl08,1990He08,1987He27

Level Scheme (continued)

Intensities: Relative I_γ



$^{40}Ca(^{40}Ca,\alpha 3p\gamma)$ 2000Pl08,1990He08,1987He27