Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 179, 1 (2022)	30-Nov-2021

Q(β^-)=279 *5*; S(n)=9951.5 *22*; S(p)=15801.9 *14*; Q(α)=−13976.5 *16* 2021Wa16
S(2n)=17227.9 *22*, S(2p)=29031.6 *23* (2021Wa16).
Mass measurements: 2016Ko45, 2014Kw04, 2013Bu12, 2012Re17, 2006Fr27.
Measurements of hyperfine structure and isotope shift: 2019Kn01, 2017Ga02, 2015Go24.
See ^{48}Ca(pol p,p′):GDR,GQR for information on the giant dipole, giant quadrupole, spin dipole, and spin quadrupole resonances.
See ^{48}Ca(e,e′n):GMR,GDR,GQR,IAR for information on the giant monopole, giant dipole, and giant quadrupole resonances.

^{48}Ca Levels

B(M1)↑ given under comments are from (p,p′), unless otherwise noted.
%β^-,%2β^- of g.s.: the small β^- decay probability together with the rather large phase space available for the 2β^- process have made ^{48}Ca a favorite for the study of the process. See the Nuclear Science References File for theoretical studies, compilations, and reviews. See 1990Al19 for a measurement of $\sigma(\theta)$ from the ^{48}Ti(n,p) reaction at E=198 MeV and its possible implications for ^{48}Ca 2β^- decay.

Cross Reference (XREF) Flags

A	^{48}K β^- decay	H	^{48}Ca(n,n′γ)	O	^{48}Ca(α,α′):giant resonance
B	^{49}K β^-n decay	I	^{48}Ca(p,p′),(pol p,p′)	P	^{48}Ca(α,$\alpha'\gamma$)
C	^{46}Ca(t,p)	J	^{48}Ca(pol p,p′):GDR,GQR	Q	^{48}Ca(^{6}Li,^{6}Li′)
D	^{48}Ca(γ,γ′),(pol γ,γ′)	K	^{48}Ca(p,p′γ)	R	^{48}Ca(^{16}O,^{16}O′)
E	^{48}Ca(e,e′)	L	^{48}Ca(d,d′),(pol d,d′)	S	^{48}Ca(^{48}Ca,^{48}Ca′γ)
F	^{48}Ca(e,e′n):GMR,GDR,GQR,IAR	M	^{48}Ca(^{3}He,^{3}He′),(pol ^{3}He,^{3}He′)		
G	^{48}Ca(π^-,π^-′),(π^+,π^+′)	N	^{48}Ca(α,α′)		

E(level)[†]	J$^\pi$	T$_{1/2}$[d]	XREF	Comments
0.0	0$^+$	2.9×10^{19}[g] y *+42−11*	ABCDE GHI KLMN PQRS	%β^-=22 *+30−22*; %2β^-=78 *+22−30* %β^-,%2β^-: From T$_{1/2}$(2β^-)=3.7×10^{19} y *+33−12* and T$_{1/2}$=2.9×10^{19} y *+42−11*. See footnote comments for T$_{1/2}$. Nuclear rms charge radius=3.4771 fm *20* (2013An02).
3831.96 *22*	2$^+$	36 fs *3*	ABCDE GHI KLMNOPQRS	J$^\pi$: 3831.4γ E2 to 0$^+$. T$_{1/2}$: weighted average of 35 fs *3* from $\Gamma_{\gamma 0}$ in (γ,γ′) (2002Ha13), 42 fs *9* from DSAM in (n,n′γ) (1992Va06), and 37 fs *17* from DSAM in (p,p′γ) (1970Be39). B(E2)↑=0.0082 *5* from (e,e′) (1985Wi06), but it is discrepant with 0.0140 *15* from (α,α′):giant res (2011Lu07) and 0.0131 *12* from (^{6}Li,^{6}Li′) (2010Kr06).
4283.56 *24*	0$^+$	223 ps *11*	ABC E HI K N S	XREF: A(?). J$^\pi$: from observation of E0 e+/e- pair emission to g.s. in (p,p′γ); L(t,p)=0 from 0$^+$. T$_{1/2}$: from pγ(t) in (p,p′γ) (1970Be39).
4503.74 *24*	4$^+$	1.53 ns *3*	A c H K M S	XREF: M(?). J$^\pi$: 671.8γ E2 to 2$^+$; 1226γ from 5$^-$. T$_{1/2}$: from pγ(t) in (p,p′γ) (1972Ta23).
4507.05 *23*	3$^-$	6.1 ps *+38−20*	A c E GHI KLMNOPQRS	J$^\pi$: 4507.3γ E3 to 0$^+$. T$_{1/2}$: from DSAM in (p,p′γ) (1970Be39). Other: 7.2 ps *+26−20* from adopted B(E3)↑=0.0069 *10*. B(E3)↑=0.0069 *10*, unweighted average of 0.0065 *10* from (e,e′), 0.0054 *8* from (α,α′):giant res, 0.0087 *8* from (^{6}Li,^{6}Li′).

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Adopted Levels, Gammas (continued)

^{48}Ca Levels (continued)

E(level)[†]	Jπ	$T_{1/2}$[d]	XREF	Comments
4612.24 *23*	$3^{(+)}$	2.5 ps *14*	A E HI K N S	XREF: N(?). Jπ: spin=3 from γγ(θ) in (p,p′γ) and γ(θ) in (n,n′γ); L(p,p′)=(4) from 0^+. $T_{1/2}$: unweighted average of 3.7 ps *+9–4* from (n,n′γ) (1992Va06) and 1.2 ps *4* from (p,p′γ) (1972Ta23).
4695.4 *3*	1	32.6[e] fs *+25–22*	D	Jπ: from γ(θ) in (γ,γ′) .
5146.42 *25*	3,4,5	<0.69 ns	E HI K N RS	Jπ: D γ to 4^+. Results are discrepant in the various experiments: 3,5 from γ(θ) in (n,n′γ); 5^+ from DWBA fit to Coulomb form factors and RPA calculation (unnatural π state from absence of longitudinal form factor) in (e,e′); 5^- from L(p,p′)=5 and observance of peak in (α,α′) (natural π state) (1988Fu01); (4) from comparison of σ(θ) and analyzing powers to those of known states in (p,p′) (1984Se10),(pol p,p′); 3^- from L(α,α′)=3. $T_{1/2}$: from direct timing in (p,p′γ) (1977Lo06).
5260.81 *23*	$4^{(-)}$	5.1 ps *+14–8*	A E HI K S	XREF: A(?). Jπ: spin=4 from γ(θ) in (n,n′γ); 4^- from DWBA fit to the Coul. form factors and RPA calc. in (e,e′) (unnatural parity state from absence of longitudinal form factor). Other: (5^+) from (p,p′) for a group at 5257 *5* is discrepant.
5311 *6*	$(1)^{-}$[a]		I K n	XREF: K(5322). Additional information 1. E(level): from (p,p′). Jπ: L(p,p′)=1 from 0^+.
5312.2 *3*	2	232 fs *+28–13*	H n	Jπ: 5312.2γ Q to 0^+.
5369.90 *23*	3^-	1.80 ps *14*	A E HI K N	Jπ: L(α,α′)=3 from 0^+.
5461 *7*	0^+		C I N	XREF: N(?). E(level): weighted average of 5459 *10* from (t,p) and 5462 *7* from (p,p′). Jπ: L(t,p)=L(p,p′)=0 from 0^+.
5729.64 *24*	5^-	0.90 ps *+49–21*	E GHI K N S	Jπ: L(α,α′)=L(p,p′)=5 from 0^+.
6105.00 *23*	(2^+)	139 fs *+17–28*	E HI K N	Jπ: L(α,α′)=(2) from 0^+; 2273.1γ to 2^+, 1597.8γ to 3^-. Other: 4^- from DWBA fit to Coulomb form in (e,e′) (unnatural π state from absence of longitudinal form factor) and (4^-) from DWBA analysis in (p,p′) (unnatural π state since peak not observed in (α,α′)) are discrepant.
6336.8 *20*	2^+	191 fs *29*	C H	Jπ: 6336.4γ E2 to 0^+.
6345.72 *24*	4^+	180 fs *+35–13*	E HI K N	XREF: K(6351). Jπ: L(α,α′)=L(p,p′)=4 from 0^+.
6.48×10^3?			N	
6612.19 *10*	1^-	1.87[e] fs *14*	A D I K P	Jπ: 6611.7γ E1 to 0^+.
6648.99 *24*	4^+	114 fs *+42–28*	C E HI K N	XREF: N(?). Jπ: L(α,α′)=L(p,p′)=4 from 0^+.
6685.64 *23*	$2^{(-)}$‡	69 fs *+56–52*	A E HI K	
6755	2^+		I N	E(level): from (p,p′). Jπ: L(α,α′)=2 from 0^+.
6791.5 *20*	1	<6.9 fs	e H	XREF: e(6796). Jπ: 6791.0γ D to 0^+.
6805.7 *3*	2^+	83 fs *+44–38*	C e HI n P	XREF: C(6793)e(6796)I(6794)n(6820)P(6800). Jπ: L(α,α′)=L(p,p′)=2 from 0^+.
6830.8 *6*	(3^-)		HI K n	XREF: n(6820). Jπ: (3) from γ(θ) in (n,n′γ); L(p,p′)=(3) from 0^+.

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Adopted Levels, Gammas (continued)

^{48}Ca Levels (continued)

E(level)[†]	Jπ	$T_{1/2}$[d]	XREF	Comments
6895.87 *24*	(2⁻)	55 fs *+83−55*	A e H k	Jπ: 2,3,4 from γ(θ) in (n,n′γ); (2−&5⁺) doublet from DWBA analysis in (p,p′) with unnatural π state since peak not observed in (α,α′) (1988Fu01).
6896 *7*	(5⁺)		E I	E(level): weighted average of 6893 *9* from (e,e′) and 6898 *7* from (p,p′). Jπ: the 5⁺ member of (2−&5⁺) doublet (see comment on Jπ(6895.87)); J≥3 *1* from comparison of σ(θ) and analyzing power to those of known states in (p,p′) (1984Se10); .
7007.6 *6*	3⁻[b]	69 fs *+18−14*	E HI	Jπ: L(p,p′)=3 and L(α,α′)=(3) from 0⁺; natural parity.
7019 *7*			e I	
7032.0 *6*	(3)⁻[b]		e HI K N	XREF: N(7050). Jπ: L(p,p′)=3+6 from 0⁺; L(α,α′)=(3) from 0⁺; (3,5) from γ(θ) in (n,n′γ); natural parity.
7.16×10³?			N	
7296.1 *5*	(2⁺)	<6.9 fs	H	Jπ: 7298γ (E2) to 0⁺.
7298.50 *20*	1⁻	0.201[e] fs *14*	A DE I K P	Jπ: 7297.9γ E1 to 0⁺. Other: L(p,p′)=3 is discrepant.
7370.6 *20*	(1,2)		H	Jπ: 7370γ to 0⁺.
7385 *10*	3⁻,(1⁻)		I	E(level),Jπ: from (p,p′), with Jπ from analysis of σ(θ).
7401.22 *23*	(2⁻)[‡#]		A E I K S	XREF: E(7397). Jπ: (4⁻) from DWBA fit to the Coulomb form factors and RPA calculations in (e,e′) (unnatural π state from absence of longitudinal form factor) discrepant. But L(p,p′)=(3) favors (3⁻).
7407.3? *5*	(0,1,2,3⁻)		A	Additional information 2. Jπ: 793.11γ to 1⁻.
7440.6 *20*	2,3⁻	177.4 fs *70*	HI K	Jπ: 7440γ Q,E3 to 0⁺.
7471 *5*	4⁺		E I	E(level): weighted average of 7476 *7* from (e,e′) and 7468 *5* from (p,p′). Jπ: L(p,p′)=4 from 0⁺ and natural parity due to presence in (α,α′) measured by 1988Fu01 in (p,p′).
7497.5 *3*	(3⁻)		HI	Jπ: (3) from analysis of σ(θ) in (p,p′) (1984Se10); 1767.8γ to 5⁻.
7536.4 *4*	3⁻#[b]		I N S	Jπ: L(p,p′)=3 from 0⁺ and natural parity.
7568.7 *6*			H	
7580 *7*			I	
7652 *10*	3⁻[&]		A c E G i K	Additional information 3. E(level): from (p,p′). Other: 7658 from ^{48}K β⁻ decay, 7657 *10* from (e,e′). Jπ: also from analysis of σ(θ) in (p,p′).
7655.66 *20*	1⁻	1.87[e] fs *7*	cD P	B(M1)↑=0.008 *5* XREF: P(7651). Jπ: 7655.0γ E1 to 0⁺.
7659 *3*	3⁻[b]		c e g I	E(level): from (p,p′). Others: 7650 *20* from (t,p) and 7657 *10* from (e,e′). Jπ: L(p,p′)=3 from 0⁺ and natural parity. B(E3)↑≈0.0014 from (e,e′).
7696	(1⁺,2⁺)[@]		E	B(M1)↑<0.05 from (e,e′). 15 additional states reported in (p,p′) by 1983Cr01 between 7.7 MeV and 12.7 MeV, seven of which appear to correspond to states observed in (e,e′).
7789 *7*	3⁻		E K N	XREF: N(7760). Additional information 4.

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Adopted Levels, Gammas (continued)

^{48}Ca Levels (continued)

E(level)[†]	Jπ	$T_{1/2}$[d]	XREF	Comments
				E(level): weighted average of 7791 *7* from (e,e′) and 7784 *10* from (p,p′). Jπ: L(α,α′)=3 from 0+.
7797 *8*	4+[b]		I	Jπ: L(p,p′)=4 from 0+ and natural parity.
7911 *7*	3−[b]		I	Jπ: L(p,p′)=3 from 0+ and natural parity.
7915.4 *9*	2+	22[e] fs *+4−3*	D	Jπ: 7914.7γ E2 to 0+.
7953? *15*	(2−,6−)[&]		E	
7957 *10*	(4)+[a]		I K	Additional information 5. E(level): from (p,p′). Jπ: L(p,p′)=4 from 0+ and not clearly seen in α spectrum (1988Fu01).
8001 *8*			c I	Jπ: natural parity state from presence in α spectra by 1988Fu01 in (p,p′).
8027.6 *4*	2+	11.4[e] fs *12*	cDe I	Jπ: 8026.9γ E2 to 0+.
8045 *8*	(1)		c e I K	Additional information 6. E(level): from (p,p′). Jπ: from analysis of σ(θ) in (p,p′); γ to 0+. Other: (1−,2+) from (e,e′) for a group at 8038 *15*.
8050	2		e P	Additional information 7. E(level): from (α,α′γ). Jπ: from αγ(θ) in (α,α′γ).
8065 *8*	5−[b]		I	Jπ: L(p,p′)=5 from 0+ and natural parity.
8082 *10*			I	
8116 *8*	1+,2+,3+		E I	E(level): weighted average of 8113 *9* from (e,e′) and 8119 *8* from (p,p′). Jπ: L(p,p′)=2 from 0+.
8150	(1+,2+)[@]		E	B(M1)↑<0.05 from (e,e′).
8178 *8*	4+[b]		I	Jπ: L(p,p′)=4 from 0+ and natural parity.
8236 *8*	4−,5−,6−		c I	XREF: c(8237). E(level): from (p,p′). Other: 8237 *20* from (t,p). Jπ: L(p,p′)=5 from 0+.
8248 *8*	4+[b]		c I K	XREF: c(8237). Additional information 8. E(level): from (p,p′). Jπ: L(p,p′)=4 from 0+ and natural parity.
8276?	(1−,2,3)		c K	XREF: c(8268). Additional information 9. E(level): reported by 1969Te03 as the same level at 8276 *10* seen in their (p,p′) measurement, however, while the level seen in thier (p,p′) could correspond to the 8283 *8* level with $J^\pi=4^+$ from 1988Fu01 in (p,p′) and the level seen in (p,p′γ) by 1969Te03 with a different Jπ could be a separate level. Jπ: 8275γ to 0+, 1456γ to (3−).
8279.1 *9*	4+#[b]		c E I n S	XREF: c(8268)n(8330). Jπ: L(p,p′)=4 from 0+ and natural parity.
8356 *8*	5−[b]		I n	XREF: n(8330). Jπ: L(p,p′)=5 from 0+ and natural parity.
8385? *18*	(3−)		E	Jπ: first maxima for Coul. Form factor at ≈1.0 fm^{-1}. in (e,e′).
8386 *8*	(6)+		i P	E(level): from (p,p′). Jπ: see comment on Jπ(8386.1).
8386.1 *5*	1−[a]	0.159[f] fs *21*	A D i K P	XREF: P(8400). Jπ: 1−&(6)+ doublet from L(p,p′)=1+6 and natural π state from presence of peak in (α,α′) spectra; 8385.3γ E1 to 0+.
8437 *5*	3−[b]		E I	E(level): weighted average of 8435 *5* from (e,e′), and 8441 *8*

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Adopted Levels, Gammas (continued)

^{48}Ca Levels (continued)

E(level)[†]	Jπ	$T_{1/2}$[d]	XREF	Comments
				from (p,p′). Jπ: L(p,p′)=3 from 0^+ and natural parity (1988Fu01).
8467?	(1,2)		A c	Additional information 10. E(level): from ^{48}K β^- decay. Jπ: 4635γ to 2^+, 8466γ to 0^+.
8478 *8*	$3^+,4^+,5^+$		c E I K	Additional information 11. E(level): from (p,p′). Other: 8477 *15* from (e,e′). Jπ: L(p,p′)=4 from 0^+.
8517.9 *8*	$(1^-,2^+)$		cD	Jπ: 8517.1γ to 0^+; $(1^-,2^+)$ is most likely from γ excitation. $T_{1/2}$: 4.6 fs *8* if $J^\pi=1^-$ or 11.4 fs *28* if $J^\pi=2^+$ from $\Gamma_{\gamma 0}$ in (γ,γ') assuming $\Gamma_{\gamma 0}/\Gamma=1$.
8523 *5*	3^-[b]		c E I K	Additional information 12. E(level): from (p,p′). Other: 8518 *8* from (e,e′). Jπ: L(p,p′)=3 from 0^+ and natural parity.
8531?	$(1,2^+)$		A c	Additional information 13. E(level): from ^{48}K β^- decay. Jπ: possible 4247γ to 0^+.
8563 *7*	(6^-)[&]		E I	E(level): weighted average of 8557 *14* from (e,e′), and 8565 *7* from (p,p′). Jπ: other: (6) assigned by 1988Fu01 based on L(p,p′)=(6) from 0^+ and uncertain existence of this state in the (α,α') spectra in 1988Fu01.
8586? *10*			I K	Additional information 14. E(level): from (p,p′).
8607 *6*	3^-[b]		C E I	E(level): weighted average of 8605 *6* from (e,e′) and 8609 *6* from (p,p′). Jπ: L(p,p′)=3 from 0^+ and natural parity.
8664.6 *11*	(3,4,5)[#]			S Jπ: 386γ to 4^+ is most likely dipole.
8680 *7*	(3^+)[‡]		c I K	Additional information 15. E(level): from (p,p′).
8698 *8*			c I	
8788 *8*			C I K	Additional information 16. E(level): from (p,p′).
8797 *8*	4^+&(6^+)[b]		I	E(level): L(p,p′)=4+6 from 0^+, with L=4 more likely.
8805 *5*	5^-		E I	E(level): weighted average of 8804 *9* from (e,e′) and 8806 *5* from (p,p′). Jπ: L(p,p′)=5 from 0^+; 5^- from DWBA analysis in (e,e′).
8831 *8*	$2^-,3^-,4^-$		I	Jπ: L(p,p′)=3 from 0^+.
8866 *8*	$4^-,5^-,6^-$		I	Jπ: L(p,p′)=5 from 0^+.
8883.3 *5*	1^-	0.42[f] fs *14*	De	P XREF: P(8900). Jπ: 8882.6γ E1 to 0^+.
8886 *6*	2^+[b]		e I	E(level): from (p,p′). Jπ: L(p,p′)=2 from 0^+ and natural parity.
8890.7 *6*	>5[#]			S Jπ: 3160.8γ to 5^-.
8920 *8*			I	
8947 *8*			I	
8967?	(1,2,3)		A I	Additional information 17. E(level): from ^{48}K β^- decay. Other: 8964 *10* from (p,p′). Jπ: 8966γ to 0^+.
8982 *8*	3^-[b]		I	Jπ: L(p,p′)=3 from 0^+ and natural parity.
9033.9 *4*	1^-	0.242[f] fs *14*	De I	Jπ: 9033γ E1 to 0^+.
9047 *9*	2^+[b]		e I	Jπ: L(p,p′)=2 from 0^+ and natural parity.
9050	1		e	P Additional information 18.

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Adopted Levels, Gammas (continued)

^{48}Ca Levels (continued)

E(level)[†]	Jπ	$T_{1/2}$[d]	XREF	Comments
				E(level): from (α,α′γ). Jπ: 9050γ D to 0+.
9079 *9*			I	
9094.6 *15*	#		S	
9123.1 *10*	(1+,2+,3+)#		I S	Jπ: L(p,p′)=2+(8) for the 9123 doublet. 9138 state appears to be the high-spin member.
9138 *22*			E	Jπ: (8−) from DWBA fit to the Coulomb form factors and RPA calculations in (e,e′); unnatural parity state from absence of longitudinal form factor; L(p,p′)=(8), Jπ=(7−) from comparison to DWBA in (p,p′). See also Jπ comment for 9123 level.
9158 *9*	(4)+[a]		I	Jπ: L(p,p′)=4 from 0+ but not clearly seen in (α,α′).
9176 *9*	2+[b]		I	Jπ: L(p,p′)=2+ from 0+ and natural parity.
9211 *9*	3−[b]		I	Jπ: L(p,p′)=3+(7) from 0+ (natural π from presence of peak in (α,α′)) in (p,p′) for the doublet. 9229 state appears to be the high-spin member.
9229	(7−)		I	Jπ: (7,8,9) from comparison of σ(θ) and analyzing power to those of known states in (p,p′),(pol p,p′); (6−,7−) from comparison to DWBA in (p,p′),(α,α′). See comment on Jπ(9211).
9232 *9*	(0−,1−,2−)		I	Jπ: L(p,p′)=(1) from 0+.
9288 *9*	(2+)&		E I	E(level): weighted average of 9290 *9* from (e,e′) and 9285 *10* from (p,p′).
9295.3 *5*	1−[b]	0.236[e] fs *14*	A D i P	XREF: P(9300). Jπ: 9294.3γ E1 to 0+. L(p,p′)=1+(8) (natural π state from presence of peak in (α,α′)) in (p,p′) for the doublet. 9296 state appears to be the L=8 member.
9295.7 *11*	(8−)#		E i S	XREF: E(9276). Jπ: (8−) from DWBA fit to the Coulomb form factors and RPA calculations in (e,e′) unnatural π state from absence of longitudinal form factor; (7,8,9) from comparison of σ(θ) and analyzing power to those of known states and (8−) from comparison to DWBA in (p,p′). See comment for Jπ(9295.3).
9307	8		I	
9334 *9*			I	
9366 *9*	5+,6+,7+		I	Jπ: L(p,p′)=6 from 0+.
9383 *10*	(1+,2+)@		E I	B(M1)↑=0.020 *2* E(level): from (p,p′). Jπ: 1+,2+ also from analysis of σ(θ) in (p,p′). B(M1)↑<0.07 from (e,e′).
9430 *9*	2−,3−,4−		I	Jπ: L(p,p′)=3 from 0+.
9472.8 *8*	1−[b]	0.250[e] fs *21*	D I P	Jπ: 9471.8γ E1 to 0+; L(p,p′)=1 from 0+ and natural parity.
9496 *9*			I	
9545.72 *20*	1−	0.139[e] fs *7*	D I P	Jπ: 9544.7γ E1 to 0+.
9550? *20*	(3−)&		E	
9568 *9*	(5+,6+,7+)		I	Jπ: L(p,p′)=(6) from 0+.
9621 *9*	4+[b]		I	Jπ: L(p,p′)=4 from 0+ and natural parity.
9645 *9*	2−,3−,4−		I	Jπ: L(p,p′)=3 from 0+.
9691 *9*	(0−,1−,2−)		I	Jπ: L(p,p′)=(1) from 0+.
9728 *9*	2−,3−,4−		I	Jπ: L(p,p′)=3 from 0+.
9765 *9*	3−[b]		I	Jπ: L(p,p′)=3 from 0+ and natural parity.

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Adopted Levels, Gammas (continued)

^{48}Ca Levels (continued)

E(level)†	Jπ	XREF	Comments
9784 *9*	$(3^+,4^+,5^+)$	I	Jπ: L(p,p′)=4 from 0^+.
9816 *9*	$(1)^-$[a]	I	Jπ: L(p,p′)=1 from 0^+ but not clearly seen in (α,α′).
9862 *9*	3^-[b]	I	Jπ: L(p,p′)=3 from 0^+ and natural parity.
9885	$(1^+,2^+)$[@]	E	B(M1)↑<0.09 from (e,e′).
9894 *7*		I	Jπ: L(p,p′)=3+(6) from 0^+.
9921 *9*	3^-[b]	I	Jπ: L(p,p′)=3 from 0^+ and natural parity.
9942 *9*	$2^-,3^-,4^-$	e I	Jπ: L(p,p′)=3 from 0^+.
9.95×10^3 *3*	(8^-)[&]	E	
9954	$(1^+,2^+)$[@]	E	B(M1)↑<0.10 from (e,e′). Jπ: from analysis of σ(θ) in (p,p′).
9973 *10*	1^+	I	B(M1)↑=0.037 *3*
9993 *9*	4^+[b]	A I	XREF: A(9985). Jπ: L(p,p′)=4 from 0^+ and natural parity.
10065 *10*	$(4)^+$[a]	a I	Jπ: L(p,p′)=4 from 0^+ but not clearly seen in (α,α′).
10081 *10*	$(3)^-$[a]	a I	Jπ: L(p,p′)=3 from 0^+ but not clearly seen in (α,α′).
10108 *10*	4^+[b]	I	Jπ: L(p,p′)=4 from 0^+ and natural parity.
10126 *10*	1^-[b]	A I	Jπ: L(p,p′)=1 from 0^+ and natural parity.
10138 *10*	$(1^+,2^+)$[@]	E I	B(M1)↑=0.148 *13* E(level): from (p,p′). B(M1)↑=0.12 *3* from (e,e′).
10151 *10*	3^-[b]	e I	Jπ: L(p,p′)=3 from 0^+ and natural parity.
10178 *10*	3^-[b]	A I	Jπ: L(p,p′)=3 from 0^+ and natural parity.
10191 *10*	3^-[b]	I	Jπ: L(p,p′)=3 from 0^+ and natural parity.
10224 *7*	1^+	E G I	B(M1)↑=3.9 *3* from (e,e′). E(level): weighted average of 10227 *5* from (e,e′) and 10211 *10* from (p,p′). Jπ: L(p,p′)=0 from 0^+; unnatural parity state from absence of peak in (α,α′).
10240?		A	
10265 *10*	$(^-)$	A I	E(level): from (p,p′). Jπ: suggested in ^{48}K β^- decay.
10288 *10*		I	B(M1)↑=0.080 *8*
10319 *10*	3^-[b]	I	Jπ: L(p,p′)=3 from 0^+ and natural parity.
10330? *10*	$(1^+,2^+)$[@]	E	B(M1)↑=0.09 *4* from (e,e′).
10345 *10*	3^-[b]	I	Jπ: L(p,p′)=3 from 0^+ and natural parity.
10350 *10*	$(1^+,2^+)$[@]	A E I	B(M1)↑=0.040 *13* E(level): from (p,p′). B(M1)↑=0.08 *4* from (e,e′).
10370 *10*	$(2)^+$[a]	A I	Jπ: L(p,p′)=2 from 0^+ but not clearly seen in (α,α′).
10390 *10*		I	B(M1)↑=0.023 *2*
10399 *10*	$3^+,4^+,5^+$	I	Jπ: L(p,p′)=4 from 0^+.
10433 *10*	$1^+,2^+,3^+$	I	Jπ: L(p,p′)=2 from 0^+.
10483 *10*	3^-[b]	I	Jπ: L(p,p′)=3 from 0^+ and natural parity.
10521 *10*	$(2)^+$[a]	I	Jπ: L(p,p′)=2 from 0^+ but not clearly seen in (α,α′).
10535 *10*	$(0^-,1^-,2^-)$	I	B(M1)↑=0.010 *3* Jπ: L(p,p′)=(1) from 0^+.
10571 *10*		I	B(M1)↑=0.060 *8* Jπ: L(p,p′)=1,2.
10586 *10*	$(4)^+$[a]	I	Jπ: L(p,p′)=4 from 0^+ but not clearly seen in (α,α′) (1988Fu01).
10610 *10*		I	B(M1)↑=0.031 *4*
10611 *10*	3^-[b]	A I	Jπ: L(p,p′)=3 from 0^+ and natural parity.
10623 *10*		I	
10645 *10*		I	B(M1)↑=0.020 *4*
10648 *10*	$(3)^-$[a]	a I	Jπ: L(p,p′)=3 from 0^+ but not clearly seen in (α,α′).

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{48}Ca Levels (continued)

E(level)†	Jπ	XREF	Comments
10686 *10*	3^{-}[b]	a I	Jπ: L(p,p′)=3 from 0^+ and natural parity.
10708 *10*		I	
10731 *10*	2^{+}[b]	I	Jπ: L(p,p′)=2 from 0^+ and natural parity.
10764 *10*		I	B(M1)↑=0.059 *29*
10782 *10*	$(1^+,2^+)$[@]	E I	E(level): from (p,p′). B(M1)↑=0.12 *4* from (e,e′).
10803 *10*	(3^-)[b]	I	Jπ: L(p,p′)=(3) from 0^+ and natural parity.
10822 *10*	3^{-}[b]	A I	Jπ: L(p,p′)=3 from 0^+ and natural parity.
10857 *10*	2^{+}[b]	I	Jπ: L(p,p′)=2 from 0^+ and natural parity.
10872 *10*	$5^+,6^+,7^+$	I	Jπ: L(p,p′)=6 from 0^+.
10883 *10*	(2^+)[b]	I	Jπ: L(p,p′)=(2) from 0^+ and natural parity.
10916 *10*	$(3)^{-}$[a]	A I	E(level): from (p,p′). Jπ: L(p,p′)=3 from 0^+ but not clearly seen in (α,α').
10935 *10*	$(1^+,2^+)$[@]	e I	B(M1)↑=0.011 *8* E(level): from (p,p′). B(M1)↑=0.05 *2* from (e,e′).
10955 *10*	4^{+}[b]	I	Jπ: L(p,p′)=4 from 0^+ and natural parity.
11013 *11*		a i	
11032?	$(^-)$	A	Jπ: suggested in ^{48}K β^- decay.
11037 *11*	(2^+)[b]	I	Jπ: L(p,p′)=(2) from 0^+ and natural parity.
11050 *11*	$(3^+,4^+,5^+)$	I	Jπ: L(p,p′)=(4) from 0^+.
11098 *11*	$2^+\&4^+$[b]	I	Jπ: L(p,p′)=2+4 from 0^+ and natural parity.
11125 *11*	$3^+,4^+,5^+$	I	Jπ: L(p,p′)=4 from 0^+.
11153 *11*		I	
11183 *11*	(5^-)[b]	I	Jπ: L(p,p′)=(5) from 0^+ and natural parity.
11219 *11*		I	
11227 *10*		I	B(M1)↑=0.012 *3*
11248 *11*	$(4)^{+}$[a]	I	Jπ: L(p,p′)=4 from 0^+ but not clearly seen in (α,α').
11281 *11*	2^{+}[b]	I	Jπ: L(p,p′)=2 from 0^+ and natural parity.
11329 *11*	3^{-}[b]	I	Jπ: L(p,p′)=3 from 0^+ and natural parity.
11376 *11*	3^{-}[b]	I	Jπ: L(p,p′)=3 from 0^+ and natural parity.
11383 *10*		I	B(M1)↑=0.003 *2*
11421 *11*	$(1^+,2^+)$[@]	E I	XREF: E(11410). B(M1)↑<0.09 from (e,e′).
11433 *11*	$1^+,2^+,3^+$	I	Jπ: L(p,p′)=2 from 0^+.
11447 *11*	$2^-,3^-,4^-$	I	Jπ: L(p,p′)=3 from 0^+.
11466 *11*		I	
11485 *11*	$(2^-,3^-,4^-)$	I	Jπ: L(p,p′)=(3) from 0^+.
11490	$(1^+,2^+)$[@]	E	B(M1)↑=0.15 *3* from (e,e′).
11508 *11*	2^{+}[b]	I	Jπ: L(p,p′)=2 from 0^+ and natural parity.
11513 *10*		I	B(M1)↑=0.021 *15*
11530 *11*	3^{-}[b]	I	Jπ: L(p,p′)=3 from 0^+ and natural parity.
11550 *11*		I	
11563 *10*		I	B(M1)↑=0.039 *5*
11589 *11*	$0^-,1^-,2^-$	I	Jπ: L(p,p′)=1 from 0^+.
11622 *11*	(4^+)[b]	I	Jπ: L(p,p′)=(4) from 0^+ and natural parity.
11639 *11*	$(1^+,2^+,3^+)$	I	Jπ: L(p,p′)=2 from 0^+.
11671 *11*	$(4^-,5^-,6^-)\&(8^-)$	I	Jπ: L(p,p′)=(5)+(8,9) from 0^+.
11693 *11*	5^{-}[b]	I	Jπ: L(p,p′)=5 from 0^+ and natural parity.
11695 *10*		I	B(M1)↑=0.025 *9*
11715 *11*	$(1^+,2^+,3^+)$	I	Jπ: L(p,p′)=(2) from 0^+.

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Adopted Levels, Gammas (continued)

^{48}Ca Levels (continued)

E(level)†	Jπ	XREF	Comments
11725 *10*	$(1^+,2^+)^@$	E I	B(M1)↑=0.014 *9* B(M1)↑=0.12 *4* from (e,e′).
11752 *11*	$(2)^+$[a]	I	Jπ: L(p,p′)=2 from 0^+ but not clearly seen in (α,α′).
11773 *11*		I	
11816 *11*	$2^-,3^-,4^-$	I	Jπ: L(p,p′)=3 from 0^+.
11828 *11*		I	
11843 *10*		I	B(M1)↑=0.030 *4*
11848 *11*		I	
11913 *11*	3^-[b]	I	Jπ: L(p,p′)=3 from 0^+ and natural parity.
11945 *11*	$(0)^+$[c]	I	Jπ: L(p,p′)=0 from 0^+ and σ(θ) fitted well assuming $J^\pi=0^+$.
11967 *11*	$(0)^+$[c]	I	Jπ: L(p,p′)=0 from 0^+ and σ(θ) fitted well assuming $J^\pi=0^+$.
11990 *10*		I	B(M1)↑=0.047 *5*
12009 *12*	(3^-)[b]	I	Jπ: L(p,p′)=(3) from 0^+ and natural parity.
12029 *12*	3^-[b]	I	Jπ: L(p,p′)=3 from 0^+ and natural parity.
12051 *12*	$(0^-,1^-,2^-)$	I	Jπ: L(p,p′)=(1) from 0^+.
12055	$(1^+,2^+)^@$	E	B(M1)↑=0.08 *3* from (e,e′).
12090 *12*	$(2^-,3^-,4^-)$	I	Jπ: L(p,p′)=(3) from 0^+.
12107 *12*	$4^-,5^-,6^-$	I	Jπ: L(p,p′)=4 from 0^+.
12121 *10*	$0^-,1^-,2^-$	I	B(M1)↑=0.048 *6* Jπ: L(p,p′)=1 from 0^+.
12162 *12*	$3^+,4^+,5^+$	I	Jπ: L(p,p′)=4 from 0^+.
12176 *12*		I	
12216 *12*	$4^-,5^-,6^-$	I	Jπ: L(p,p′)=5 from 0^+.
12271 *12*	$(3^+,4^+,5^+)$	e I	Jπ: L(p,p′)=(4) from 0^+.
12275 *10*	$(1^+,2^+)^@$	E I	B(M1)↑=0.035 *19* XREF: E(12270). B(M1)↑=0.10 *5* from (e,e′).
12318 *12*	$(0)^+$[c]	E I	XREF: E(12310). Jπ: (M1) transition in (e,e′) is inconsistent. B(M1)↑=0.11 *3* from (e,e′).
12338 *10*	$(1,2)^+$	I	B(M1)↑=0.070 *9* Jπ: L(p,p′)=2 from 0^+; (M1) transition with E2 not excluded due to weakness of this transition.
12369 *12*	$(3^+,4^+,5^+)$	I	Jπ: L(p,p′)=(4) from 0^+.
12422 *12*	$1^+,2^+,3^+$	I	Jπ: L(p,p′)=2 from 0^+.
12441 *12*	$2^-,3^-,4^-$	I	Jπ: L(p,p′)=3 from 0^+.
12478 *10*		I	B(M1)↑=0.025 *13*
12499 *12*	$(1^+,2^+)^@$	E I	B(M1)↑=0.09 *4* from (e,e′).
12540 *12*	$1^+,2^+,3^+$	I	Jπ: L(p,p′)=2 from 0^+.
12565 *12*	$(0)^+$[c]	I	Jπ: L(p,p′)=0 from 0^+.
12620 *12*	$1^+,2^+,3^+$	I	Jπ: L(p,p′)=2 from 0^+.
12623 *10*		I	B(M1)↑=0.054 *20*
12659 *10*		I	B(M1)↑=0.077 *6*
12667 *12*		I	
12693 *10*	$(1^+,2^+)^@$	E I	B(M1)↑=0.035 *5* B(M1)↑=0.10 *5* from (e,e′).
12704 *12*		I	
12757 *12*	$1^+,2^+,3^+$	I	Jπ: L(p,p′)=2 from 0^+.
12798 *12*	$1^+,2^+,3^+$	I	Jπ: L(p,p′)=2 from 0^+.
12846 *12*		I	
12869 *12*	$(0^+)^c$	I	Jπ: L(p,p′)=(0) from 0^+.
12918 *10*		I	B(M1)↑=0.048 *40*
12925 *12*	$1^+,2^+,3^+$	I	Jπ: L(p,p′)=2 from 0^+.
12968 *12*	$(2^-,3^-,4^-)$	I	Jπ: L(p,p′)=(3) from 0^+.

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Adopted Levels, Gammas (continued)

^{48}Ca Levels (continued)

E(level)[†]	Jπ	$T_{1/2}$[d]	XREF	Comments
13030 *13*	$4^-,5^-,6^-$		I	Jπ: L(p,p′)=5 from 0^+.
13065 *13*	$(1^+,2^+,3^+)$		I	Jπ: L(p,p′)=(2) from 0^+.
13098 *13*	$1^+,2^+,3^+$		I	Jπ: L(p,p′)=2 from 0^+.
13169 *13*	$0^-,1^-,2^-$		I	Jπ: L(p,p′)=1 from 0^+.
13223 *13*			I	
13256 *13*	$2^-,3^-,4^-$		I	Jπ: L(p,p′)=3 from 0^+.
13290 *13*			I	
13360 *13*	$1^+,2^+,3^+$		I	Jπ: L(p,p′)=2 from 0^+.
13403 *13*	$1^+,2^+,3^+$		I	Jπ: L(p,p′)=2 from 0^+.
13439 *13*			I	
13475 *13*	$1^+,2^+,3^+$		I	Jπ: L(p,p′)=2 from 0^+.
13493 *13*			I	
16.69×10^3 *19*		6.2 MeV *+15−1*	0	E1 resonance.
16.79×10^3 *14*		6.95 MeV *+11−35*	0	E2 resonance.
19.88×10^3 *18*		6.68 MeV *+31−36*	0	E0 (ISGMR) resonance.
20.90×10^3 *14*		9.34 MeV *16*	0	E3+E4 resonance.
24.2×10^3	(1^-)		F	%n=100 T=(5) Jπ,T: momentum transfer dependence favors an E1 excitation and small Γ implies an isobaric analog resonance in (e,e′n).
37.3×10^3 *20*		14.9 MeV *+35−1*	0	E1 resonance.

[†] From a least-squares fit to γ-ray energies for levels connected with γ transitions except for those from (p,p′γ), and from (p,p′) for other levels where available, unless otherwise noted. In the least-squares fit, where ΔEγ is not available, the following assumptions have been made: 0.05 keV for Eγ quoted to 100th keV, 0.5 keV for Eγ quoted to 10th keV and 1.0 keV for quoted to keV. The reduced χ^2 of the fitting is 2.65, compared to the critical χ^2=1.83, after adjustments of ΔEγ for some poor-fit Eγ values, as noted.

[‡] From DWBA analysis in (p,p′) with unnatural parity due to peak not observed in (α,α′) spectra (1988Fu01). Natural parity is distinguished from unnatural parity based on observation of one-to-one correspondences of levels in (p,p′) and (α,α′) spectra (1988Fu01).

[#] In (^{48}Ca,^{48}Ca′γ), 2001Br35 suggest that these states are near yrast states with J>5 and must involve two-particle two-hole core excitations, which is manifested by their large energy separation from lower lying states.

[@] (M1) transition in (e,e′) gives (1^+); E2 giving 2^+ may not be excluded due to the weakness of the transition.

[&] From DWBA fit to the Coulomb form factors and RPA calculations in (e,e′); unnatural parity state from absence of longitudinal form factor.

[a] Likely spin but not clearly observed in (α,α′) spectra measured by 1988Fu01 in (p,p′).

[b] Natural parity state due to presence in the (α,α′) spectra measured by 1988Fu01 in (p,p′).

[c] σ(θ) in (p,p′) show oscillatory patterns and are well fitted by DWBA assuming 0^+.

[d] From DSAM in (n,n′γ) (1992Va06), unless otherwise noted.

[e] From $\Gamma_{\gamma0}$ in (γ,γ′) assuming $\Gamma_{\gamma0}/\Gamma$=1 (2002Ha13).

[f] From $\Gamma_{\gamma0}$ in (γ,γ′) (2002Ha13) and adopted $\Gamma_{\gamma0}/\Gamma$.

[g] Estimated by the evaluator from the following partial $T_{1/2}$ and limits: $T_{1/2}(\beta^-)>1.6\times10^{20}$ y, $>2.5\times10^{20}$ y, $>1.9\times10^{20}$ y for single β^- decay to g.s., 131 and 252 levels in ^{48}Sc, respectively (2002Bb03, 90% C.L.), $T_{1/2}(2\nu2\beta^-)=5.6\times10^{19}$ y *+14−11* (2016Ar19,2000Br63,1996Ba80) and $T_{1/2}(0\nu2\beta^-)>5.8\times10^{22}$ y (2008Um05, 90% C.L.), for $2\beta^-$ to g.s. in ^{48}Ti, and $T_{1/2}(2\beta^-)>1.8\times10^{20}$ y, $>1.5\times10^{20}$ y, and $>1.5\times10^{20}$ y (2002Bb03, 90% C.L.), for $(0\nu+2\nu)2\beta^-$ to 984, 2421, and 2997 levels in ^{48}Ti, respectively. Estimate was obtained by taking decay constant $\lambda=\lambda_{upper}/2$ with $\Delta\lambda=\lambda$ for partial $T_{1/2}$ given as lower limit (for λ_{upper}). See the ^{48}Ca β^- and ^{48}Ca $2\beta^-$ decay datasets for experimental details.

Adopted Levels, Gammas (continued)

γ(^{48}Ca)

E_i(level)	J_i^π	E_γ[‡]	I_γ[#]	E_f	J_f^π	Mult.[e]	δ[e]	α[†]	$I_{(\gamma+ce)}$[b]	Comments
3831.96	2^+	3831.4 *3*	100	0.0	0^+	E2		1.12×10^{-3} *2*		B(E2)(W.u.)=1.84 *+17−14* α(K)=6.68×10^{-6} *9*; α(L)=5.71×10^{-7} *8*; α(M)=6.78×10^{-8} *9* α(N)=3.86×10^{-9} *5*; α(IPF)=0.001111 *16* E_γ: weighted average of 3831.3 *2* from (γ,γ′) and 3832.2 *5* from (n,n′γ). Mult.: Q from pγ(θ) in (p,p′γ) and M2 ruled out by RUL.
4283.56	0^+	451.6 *1*	100.0[b] *10*	3831.96	2^+	[E2]		0.000934 *13*		B(E2)(W.u.)=10.1 *5* α=0.000934 *13*; α(K)=0.000851 *12*; α(L)=7.37×10^{-5} *10*; α(M)=8.73×10^{-6} *12* α(N)=4.89×10^{-7} *7* E_γ: from (n,n′γ). Other: 451.9 *5* from (p,p′γ). I_γ: from (p,p′γ). Other: 100 *13* from ^{49}K β^-n decay.
		(4283)		0.0	0^+	E0			29.0 *11*	Mult.: from observation of E0 e+/e- pair emission to g.s. q^2_K(E0/E2)=0.95 *4*; X(E0/E2)=0.0503 *19*; ρ^2(E0)=0.0145 *9* (2005Ki02,1970Be39). ω(E0)=4.817×10^{10}; ω(E0)(K)=1.342×10^{8}; ω(E0)(ipf)=4.817×10^{10}.
4503.74	4^+	671.8 *4*	100	3831.96	2^+	E2		0.000268 *4*		B(E2)(W.u.)=0.261 *5* α=0.000268 *4*; α(K)=0.0002441 *34*; α(L)=2.106×10^{-5} *30*; α(M)=2.498×10^{-6} *35* α(N)=1.408×10^{-7} *20* E_γ: unweighted average of 671.4 *1* from (n,n′γ) and 672.1 *2* from (p,p′γ). Mult.: Q from γ(θ) in (n,n′γ); M2 ruled out by RUL.
4507.05	3^-	675.1 *1*	100.0 *28*	3831.96	2^+	(E1(+M2))	0.00 *3*	9.18×10^{-5} *13*		B(E1)(W.u.)=0.00021 *+10−8* α=9.18×10^{-5} *13*; α(K)=8.37×10^{-5} *12*; α(L)=7.19×10^{-6} *10*; α(M)=8.53×10^{-7} *12* α(N)=4.83×10^{-8} *7* E_γ: from (n,n′γ). Other: 675.0 *1* from (p,p′γ). I_γ: from (p,p′γ). Others: 100 *4* from ^{48}K β^- decay and 100 *8* from (n,n′γ). Mult.,δ: D(+Q) and δ from pγ(θ) in (p,p′γ); Δπ=yes from level scheme.
		4507.3 *5*	28 *5*	0.0	0^+	E3		1.05×10^{-3} *2*		B(E3)(W.u.)=8.4 *+43−35* α(K)=6.86×10^{-6} *10*; α(L)=5.87×10^{-7} *8*; α(M)=6.97×10^{-8} *10*

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Adopted Levels, Gammas (continued)

γ(^{48}Ca) (continued)

E_i(level)	J_i^π	E_γ[‡]	I_γ[#]	E_f	J_f^π	Mult.[e]	δ[e]	α[†]	Comments
									α(N)=3.97×10^{-9} *6*; α(IPF)=0.001042 *15* I_γ: unweighted average of 22 *6* from ^{48}K β$^-$ decay, 25.0 *28* from (n,n′γ), and 37.0 *28* from (p,p′γ). I_γ: Iγ(4507γ)/Iγ(675γ)=0.37 *3* from (p,p′γ) discrepant, 0.22 *6* from β$^-$ decay consistent. Mult.: O from pγ(θ) in (p,p′γ); M3 ruled out by RUL.
4612.24	3$^{(+)}$	780.2 *1*	100	3831.96	2$^+$	(M1)		0.0001108 *16*	B(M1)(W.u.)=0.019 *+17−7* α=0.0001108 *16*; α(K)=0.0001010 *14*; α(L)=8.68×10^{-6} *12*; α(M)=1.031×10^{-6} *14* α(N)=5.85×10^{-8} *8* E_γ: weighted average of 780.1 *1* from (n,n′γ) and 780.4 *2* from (p,p′γ). Mult.: D from γγ(θ) in (p,p′γ) and γ(θ) in (n,n′γ); Δπ=(no) from level scheme.
4695.4	1	4695.2[@] *3*	100	0.0	0$^+$	D			E_γ,Mult.: from (γ,γ′), with Mult from γ(θ).
5146.42	3,4,5	642.7 *1*	100	4503.74	4$^+$	D			E_γ: other: 642.9 *2* from (p,p′γ).
5260.81	4$^{(-)}$	648.4 *1*	16.8 *17*	4612.24	3$^{(+)}$	(E1)		0.0001008 *14*	B(E1)(W.u.)=5.3×10^{-5} *+10−12* α=0.0001008 *14*; α(K)=9.19×10^{-5} *13*; α(L)=7.89×10^{-6} *11*; α(M)=9.37×10^{-7} *13* α(N)=5.30×10^{-8} *7* I_γ: other: I(648γ)/I(754γ)=100 *20*/41 *20* from (p,p′γ) is discrepant. Mult.: D from γ(θ) in (n,n′γ); Δπ=(yes) from level scheme.
		753.8 *1*	100 *9*	4507.05	3$^-$	(M1)		0.0001188 *17*	B(M1)(W.u.)=0.0086 *+16−19* α=0.0001188 *17*; α(K)=0.0001083 *15*; α(L)=9.31×10^{-6} *13*; α(M)=1.106×10^{-6} *15* α(N)=6.28×10^{-8} *9* E_γ: other: 753.9 from (^{48}Ca,^{48}Ca′γ). Mult.: D from γ(θ) in (n,n′γ); Δπ=(no) from level scheme.
		757.7[ag]		4503.74	4$^+$				E_γ: from (^{48}Ca,^{48}Ca′γ).
5311	(1)$^-$	804	25[b] *13*	4507.05	3$^-$				E_γ: original 810 from (p,p′γ).
		1479	100[b] *13*	3831.96	2$^+$				E_γ: original 1490 from (p,p′γ).
5312.2	2	803.9[c] *1*	5.7 *10*	4507.05	3$^-$	D			E_γ: level-energy difference=805.17.
		1480.2[d] *1*	100 *8*	3831.96	2$^+$	D+Q	+0.7 *6*		
		5312.2 *5*	15.4 *18*	0.0	0$^+$	Q			Mult.: M2 or E2 both allowed by RUL.
5369.90	3$^-$	757.5 *1*	29 *4*	4612.24	3$^{(+)}$	(E1)		7.10×10^{-5} *10*	B(E1)(W.u.)=0.000102 *15* α=7.10×10^{-5} *10*; α(K)=6.47×10^{-5} *9*; α(L)=5.56×10^{-6} *8*; α(M)=6.59×10^{-7} *9* α(N)=3.74×10^{-8} *5* I_γ: other: 6.3 *4* from ^{48}K β$^-$ decay is discrepant. Mult.: D from γ(θ) in (n,n′γ); Δπ=yes from level scheme.

$^{48}_{20}Ca_{28}$-12

Adopted Levels, Gammas (continued)

γ(^{48}Ca) (continued)

E_i(level)	J_i^π	E_γ[‡]	I_γ[#]	E_f	J_f^π	Mult.[e]	α[†]	Comments
5369.90	3⁻	862.7 *1*	30 *4*	4507.05	3⁻	[M1,E2]	0.000112 *22*	B(M1)(W.u.)=0.00308 *+46−43* (if pure M1); B(E2)(W.u.)=10.3 *+15−14* (if pure E2) α=0.000112 *22*; α(K)=0.000102 *20*; α(L)=8.8×10^{-6} *17*; α(M)=1.04×10^{-6} *20* α(N)=5.9×10^{-8} *11* I_γ: weighted average of 29 *4* from ^{48}K β^- decay and 30 *4* from (n,n′γ). Other: 67 *17* from (p,p′γ) is discrepant.
		866.9[d] *1*	26.4 *32*	4503.74	4⁺	(E1)	5.33×10^{-5} *7*	B(E1)(W.u.)=6.2×10^{-5} *+9−8* α=5.33×10^{-5} *7*; α(K)=4.86×10^{-5} *7*; α(L)=4.17×10^{-6} *6*; α(M)=4.95×10^{-7} *7* α(N)=2.81×10^{-8} *4* E_γ: level-energy difference=866.16. I_γ: weighted average of 23 *4* from ^{48}K β^- decay and 28.6 *32* from (n,n′γ). Mult.: D from γ(θ) in (n,n′γ); Δπ=yes from level scheme.
		1537.8 *1*	100 *6*	3831.96	2⁺	(E1)	0.000312 *4*	B(E1)(W.u.)=4.2×10^{-5} *4* α=0.000312 *4*; α(K)=1.715×10^{-5} *24*; α(L)=1.468×10^{-6} *21*; α(M)=1.743×10^{-7} *24* α(N)=9.91×10^{-9} *14*; α(IPF)=0.000293 *4* I_γ: from ^{48}K β^- decay. Others: 100 *9* from (n,n′γ) and 100 *17* from (p,p′γ). Mult.: D from γ(θ) in (n,n′γ); Δπ=yes from level scheme.
5729.64	5⁻	468.7 *1*	100 *9*	5260.81	4$^{(-)}$	[M1]	0.000324 *5*	B(M1)(W.u.)=0.14 *5* α=0.000324 *5*; α(K)=0.000295 *4*; α(L)=2.55×10^{-5} *4*; α(M)=3.03×10^{-6} *4* α(N)=1.713×10^{-7} *24* I_γ: from (n,n′γ). Other: 100 *17* from (p,p′γ). Mult.: assumed based on comparions with RUL.
		1226.0 *1*	65 *14*	4503.74	4⁺	[E1]	0.0001000 *14*	B(E1)(W.u.)=0.00012 *+4−5* α=0.0001000 *14*; α(K)=2.511×10^{-5} *35*; α(L)=2.151×10^{-6} *30*; α(M)=2.55×10^{-7} *4* α(N)=1.451×10^{-8} *20*; α(IPF)=7.25×10^{-5} *10* I_γ: weighted average of 63 *14* from (n,n′γ) and 67 *17* from (p,p′γ).
6105.00	(2⁺)	1597.8 *1*	100 *10*	4507.05	3⁻	[E1]	0.000359 *5*	B(E1)(W.u.)=0.00079 *+19−9* α=0.000359 *5*; α(K)=1.613×10^{-5} *23*; α(L)=1.381×10^{-6} *19*; α(M)=1.640×10^{-7} *23* α(N)=9.32×10^{-9} *13*; α(IPF)=0.000341 *5*
		2273.1 *1*	13.7 *20*	3831.96	2⁺	[M1,E2]	0.00042 *4*	B(M1)(W.u.)=0.0016 *+5−3* (if pure M1); B(E2)(W.u.)=0.78 *+24−14* (if pure E2) α=0.00042 *4*; α(K)=1.49×10^{-5} *6*; α(L)=1.28×10^{-6} *5*; α(M)=1.52×10^{-7} *6* α(N)=8.63×10^{-9} *32*; α(IPF)=0.00041 *4*

$^{48}_{20}Ca_{28}$-13

Adopted Levels, Gammas (continued)

γ(^{48}Ca) (continued)

E_i(level)	J_i^π	E_γ[‡]	I_γ[#]	E_f	J_f^π	Mult.[e]	α[†]	Comments
6336.8	2^+	6336.4 *20*	100	0.0	0^+	E2		B(E2)(W.u.)=0.028 *+5−4*
6345.72	4^+	1199.3 *1*	17 *8*	5146.42	3,4,5			
		1733.5 *1*	20 *5*	4612.24	$3^{(+)}$			
		1841.2[d] *1*	100 *11*	4503.74	4^+			E_γ: level-energy difference=1841.94.
6612.19	1^-	6611.7[@] *1*	100	0.0	0^+	E1		B(E1)(W.u.)=0.00095 *+8−7* Mult.: $\gamma(\theta)$ and γ asymmetry in (γ,γ').
6648.99	4^+	1278[g]		5369.90	3^-			
		1504.0[c] *1*	68 *8*	5146.42	3,4,5	D		E_γ: level-energy difference=1502.54.
		2036.8 *1*	51 *5*	4612.24	$3^{(+)}$	(M1)	0.000283 *4*	B(M1)(W.u.)=0.0053 *+19−15* α=0.000283 *4*; α(K)=1.724×10^{-5} *24*; α(L)=1.476×10^{-6} *21*; α(M)=1.753×10^{-7} *25* α(N)=9.98×10^{-9} *14*; α(IPF)=0.000264 *4* Mult.: D from $\gamma(\theta)$ in (n,n′γ); Δπ=no from level scheme.
		2145.1 *1*	100 *16*	4503.74	4^+	(M1)	0.000327 *5*	B(M1)(W.u.)=0.009 *3* α=0.000327 *5*; α(K)=1.583×10^{-5} *22*; α(L)=1.354×10^{-6} *19*; α(M)=1.609×10^{-7} *23* α(N)=9.16×10^{-9} *13*; α(IPF)=0.000310 *4* Mult.: D from $\gamma(\theta)$ in (n,n′γ); Δπ=no from level scheme.
6685.64	$2^{(-)}$	1315.8 *1*	100 *8*	5369.90	3^-	[M1,E2]	7.3×10^{-5} *9*	B(M1)(W.u.)=0.10 *+13−5* (if pure M1); B(E2)(W.u.)=1.5×10^2 *+19−7* (if pure E2) α=7.3×10^{-5} *9*; α(K)=4.1×10^{-5} *4*; α(L)=3.49×10^{-6} *33*; α(M)=4.2×10^{-7} *4* α(N)=2.36×10^{-8} *22*; α(IPF)=2.8×10^{-5} *5* I_γ: from ^{48}K β^- decay. Other: 100 *10* from (n,n′γ).
		2073.9[d] *1*	17 *4*	4612.24	$3^{(+)}$	(E1)	0.000705 *10*	B(E1)(W.u.)=1.0×10^{-4} *+13−5* α=0.000705 *10*; α(K)=1.089×10^{-5} *15*; α(L)=9.31×10^{-7} *13*; α(M)=1.106×10^{-7} *15* α(N)=6.29×10^{-9} *9*; α(IPF)=0.000693 *10* E_γ: level-energy difference=2073.35. I_γ: weighted average of 15 *4* from ^{48}K β^- decay and 26 *9* from (n,n′γ). Mult.: D from comparison to RUL; Δπ=yes from level scheme.
		2178.30[&g]	18[&] *4*	4507.05	3^-	[M1,E2]	0.00038 *4*	B(M1)(W.u.)=0.0041 *+52−21* (if pure M1); B(E2)(W.u.)=2.2 *+28−11* (if pure E2) α=0.00038 *4*; α(K)=1.60×10^{-5} *6*; α(L)=1.37×10^{-6} *5*; α(M)=1.63×10^{-7} *7* α(N)=9.3×10^{-9} *4*; α(IPF)=0.00036 *4* E_γ,I_γ: from ^{48}K β^- decay. γ reported in (p,p′γ) but not seen in (n,n′γ).
6791.5	1	6791.0 *20*	100	0.0	0^+	D		
6805.7	2^+	2301.9 *1*	100 *14*	4503.74	4^+	[E2]	0.000478 *7*	B(E2)(W.u.)=5.9 *+48−22* α=0.000478 *7*; α(K)=1.510×10^{-5} *21*; α(L)=1.292×10^{-6} *18*; α(M)=1.535×10^{-7} *21* α(N)=8.73×10^{-9} *12*; α(IPF)=0.000462 *6*
		2974.8 *5*	72 *24*	3831.96	2^+	[M1,E2]	0.00073 *6*	B(M1)(W.u.)=0.0042 *+36−17* (if pure M1); B(E2)(W.u.)=1.2 *+10−5* (if

$^{48}_{20}Ca_{28}$-14

Adopted Levels, Gammas (continued)

γ(^{48}Ca) (continued)

E_i(level)	J_i^π	E_γ[‡]	I_γ[#]	E_f	J_f^π	Mult.[e]	α[†]	Comments
								pure E2) α=0.00073 *6*; α(K)=9.64×10^{-6} *26*; α(L)=8.24×10^{-7} *22*; α(M)=9.79×10^{-8} *26* α(N)=5.58×10^{-9} *15*; α(IPF)=0.00072 *6*
6830.8	(3$^-$)	2998.7 *5*	100	3831.96	2$^+$	D		
6895.87	(2$^-$)	1525.7 *1*	36 *6*	5369.90	3$^-$	(M1)	0.0001032 *14*	B(M1)(W.u.)>0.0065 α=0.0001032 *14*; α(K)=2.83×10^{-5} *4*; α(L)=2.426×10^{-6} *34*; α(M)=2.88×10^{-7} *4* α(N)=1.640×10^{-8} *23*; α(IPF)=7.21×10^{-5} *10* I_γ: from ^{48}K β$^-$ decay. Other: 35 *8* from (n,n′γ). Mult.: D from γ(θ) in (n,n′γ); Δπ=(no) from level scheme.
		2283.15[&g]	23[&] *4*	4612.24	3$^{(+)}$	[E1]	0.000843 *12*	B(E1)(W.u.)>2.8×10^{-5} α=0.000843 *12*; α(K)=9.50×10^{-6} *13*; α(L)=8.12×10^{-7} *11*; α(M)=9.65×10^{-8} *14* α(N)=5.49×10^{-9} *8*; α(IPF)=0.000833 *12*
		2389.0 *1*	100 *7*	4507.05	3$^-$	(M1)	0.000428 *6*	B(M1)(W.u.)>0.0053 α=0.000428 *6*; α(K)=1.329×10^{-5} *19*; α(L)=1.137×10^{-6} *16*; α(M)=1.350×10^{-7} *19* α(N)=7.69×10^{-9} *11*; α(IPF)=0.000413 *6* I_γ: from ^{48}K β$^-$ decay. Other: 100 *14* from (n,n′γ). Mult.: D from γ(θ) in (n,n′γ); Δπ=(no) from level scheme.
		3063.27[&g]	35[&] *7*	3831.96	2$^+$			E_γ,I_γ: from ^{48}K β$^-$ decay only.
7007.6	3$^-$	3175.5 *5*	100	3831.96	2$^+$	[E1]	1.33×10^{-3} *2*	B(E1)(W.u.)=0.00023 *+6−5* α(K)=6.12×10^{-6} *9*; α(L)=5.23×10^{-7} *7*; α(M)=6.21×10^{-8} *9* α(N)=3.54×10^{-9} *5*; α(IPF)=0.001328 *19*
7032.0	(3)$^-$	1771[g]		5260.81	4$^{(-)}$			E_γ: level-energy difference=1763 from (p,p′γ).
		2524.9 *5*	100	4507.05	3$^-$	D+Q		δ: large.
7296.1	(2$^+$)	3463.9 *5*	100 *11*	3831.96	2$^+$			
		7298 *2*	21 *4*	0.0	0$^+$	(E2)		B(E2)(W.u.)>0.051 Mult.: (Q) from γ(θ) in (n,n′γ); M2 ruled out by RUL.
7298.50	1$^-$	1929[&]	0.52[&]	5369.90	3$^-$			E_γ: 1932 from level-energy difference in ^{48}K β$^-$ decay.
		2686[&]	0.52[&]	4612.24	3$^{(+)}$			E_γ: 2689 from level-energy difference in ^{48}K β$^-$ decay.
		7297.9 *2*	100 *26*	0.0	0$^+$	E1		B(E1)(W.u.)=0.0065 *5* E_γ: from (γ,γ′). Other: 7300.9 from ^{48}K β$^-$ decay. I_γ: from ^{48}K β$^-$ decay. Mult.: from γ(θ) and γ asymmetry in (γ,γ′).
7370.6	(1,2)	7370 *2*	100	0.0	0$^+$			
7401.22	(2$^-$)	715.61[&]	8.2[&] *24*	6685.64	2$^{(-)}$			
		2031.23[&]	17.9[&] *24*	5369.90	3$^-$			
		2788.90[&]	100[&] *6*	4612.24	3$^{(+)}$			

Adopted Levels, Gammas (continued)

γ(^{48}Ca) (continued)

E_i(level)	J_i^π	E_γ ‡	I_γ #	E_f	J_f^π	Mult. e	α †	Comments
7401.22	(2⁻)	2894 &	5.3 &	4507.05	3⁻			
		3569 &	6.6 &	3831.96	2⁺			
		7400 &	1.30 &	0.0	0⁺			
7407.3?	(0,1,2,3⁻)	793.11 & g 6	100	6612.19	1⁻			
7440.6	2,3⁻	7440 2	100	0.0	0⁺	Q,E3		B(E3)(W.u.)=39.7 +17−15 (if pure E3)
7497.5	(3⁻)	1767.8 1	100	5729.64	5⁻			
7536.4	3⁻	2389.8 a		5146.42	3,4,5			
		3032.7 a		4503.74	4⁺			
7568.7		3736.6 5	100	3831.96	2⁺			
7652	3⁻	3146 f g		4503.74	4⁺			E_γ: level-energy difference=3140 from (p,p′γ).
		3146 f g		4507.05	3⁻			E_γ: level-energy difference=3140 from (p,p′γ).
		7651		0.0	0⁺			
7655.66	1⁻	7655.0 @ 2	100	0.0	0⁺	E1		B(E1)(W.u.)=6.11×10^{-4} +24−23 Mult.: from γ(θ) and α asymmetry in (γ,γ′).
7789	3⁻	958		6830.8	(3⁻)			E_γ: level-energy difference=964 from (p,p′γ).
7915.4	2⁺	7914.7 @ 9	100	0.0	0⁺	E2		B(E2)(W.u.)=0.080 +13−12
7957	(4)⁺	1126		6830.8	(3⁻)			E_γ: level-energy difference=1137 from (p,p′γ).
8027.6	2⁺	8026.9 @ 4	100	0.0	0⁺	E2		B(E2)(W.u.)=0.144 +17−14 Mult.: Q from γ(θ) in (γ,γ′); M2 ruled out by RUL.
8045	(1)	3544 f g		4503.74	4⁺			E_γ: level-energy difference=3529 from (p,p′γ).
		3544 f g		4507.05	3⁻			E_γ: level-energy difference=3529 from (p,p′γ).
		8044 g		0.0	0⁺			E_γ: level-energy difference=8040 from (p,p′γ).
8050	2	8050		0.0	0⁺			
8248	4⁺	3740 f g		4503.74	4⁺			E_γ: level-energy difference=3735 from (p,p′γ).
		3740 f g		4507.05	3⁻			E_γ: level-energy difference=3735 from (p,p′γ).
8276?	(1⁻,2,3)	1445		6830.8	(3⁻)			E_γ: level-energy difference=1456 from (p,p′γ).
		3770 f g		4507.05	3⁻			E_γ: level-energy difference=3764 from (p,p′γ).
		3770 f g		4503.74	4⁺			E_γ: level-energy difference=3764 from (p,p′γ).
		8275		0.0	0⁺			
8279.1	4⁺	3133 a		5146.42	3,4,5			
8386.1	1⁻	1555 g		6830.8	(3⁻)			E_γ: level-energy difference=1564 from (p,p′γ).
		4554.2 @ 12	9.9 @ 3	3831.96	2⁺	(E1)	1.88×10^{-3} 3	B(E1)(W.u.)=0.0031 +6−4 α(K)=3.93×10^{-6} 5; α(L)=3.35×10^{-7} 5; α(M)=3.98×10^{-8} 6 α(N)=2.269×10^{-9} 32; α(IPF)=0.001876 26 Mult.: D from γ(θ) in (γ,γ′); Δπ=yes from level scheme.
		8385.3 @ 5	100 @ 9	0.0	0⁺	E1		B(E1)(W.u.)=0.0050 +8−6 Mult.: from γ(θ) and γ asymmetry in (γ,γ′).
8467?	(1,2)	4635 & g	100 &	3831.96	2⁺			
		8466 & g	15.7 &	0.0	0⁺			

Adopted Levels, Gammas (continued)

γ(^{48}Ca) (continued)

E_i(level)	J_i^π	E_γ[‡]	I_γ[#]	E_f	J_f^π	Mult.[e]	α[†]	Comments
8478	3$^+$,4$^+$,5$^+$	3972[f g]		4503.74	4$^+$			E_γ: level-energy difference=3976 from (p,p′γ).
		3972[f g]		4507.05	3$^-$			E_γ: level-energy difference=3976 from (p,p′γ).
8517.9	(1$^-$,2$^+$)	8517.1[@] *8*	100	0.0	0$^+$			
8523	3$^-$	4017[f g]		4503.74	4$^+$			E_γ: level-energy difference=4015 from (p,p′γ).
		4017[f g]		4507.05	3$^-$			E_γ: level-energy difference=4015 from (p,p′γ).
8531?	(1,2$^+$)	4247[& g]	39[&]	4283.56	0$^+$			
		4699[& g]	100[&]	3831.96	2$^+$			
		8530[& g]	61[&]	0.0	0$^+$			
8586?		4080[f g]		4503.74	4$^+$			E_γ: level-energy difference=4073 from (p,p′γ).
		4080[f g]		4507.05	3$^-$			E_γ: level-energy difference=4073 from (p,p′γ).
8664.6	(3,4,5)	386[a]		8279.1	4$^+$			
8680	(3$^+$)	4174[f g]		4503.74	4$^+$			E_γ: level-energy difference=4159 from (p,p′γ).
		4174[f g]		4507.05	3$^-$			E_γ: level-energy difference=4159 from (p,p′γ).
8788		4282[f g]		4503.74	4$^+$			E_γ: level-energy difference=4277 from (p,p′γ).
		4282[f g]		4507.05	3$^-$			E_γ: level-energy difference=4277 from (p,p′γ).
8883.3	1$^-$	5050.6 *9*	4.0 *10*	3831.96	2$^+$	(E1)	2.04×10^{-3} *3*	B(E1)(W.u.)=0.00036 *+30−14* α(K)=3.48×10^{-6} *5*; α(L)=2.97×10^{-7} *4*; α(M)=3.52×10^{-8} *5* α(N)=2.008×10^{-9} *28*; α(IPF)=0.002035 *28* E_γ,I_γ: from (γ,γ′). Mult.: D from γ(θ) in (γ,γ′); Δπ=yes from level scheme.
		8882.6 *5*	100 *30*	0.0	0$^+$	E1		B(E1)(W.u.)=0.0017 *+9−4* E_γ,I_γ,Mult.: from (γ,γ′) with Mult from γ(θ) and γ asymmetry.
8890.7	>5	3160.8[a]		5729.64	5$^-$			
8967?	(1,2,3)	8966[& g]	100	0.0	0$^+$			
9033.9	1$^-$	5200.9[@] *15*	2.2[@] *9*	3831.96	2$^+$	(E1)	2.08×10^{-3} *3*	B(E1)(W.u.)=0.00033 *13* α(K)=3.36×10^{-6} *5*; α(L)=2.87×10^{-7} *4*; α(M)=3.41×10^{-8} *5* α(N)=1.940×10^{-9} *27*; α(IPF)=0.002080 *29* Mult.: D from γ(θ) in (γ,γ′); Δπ=yes from level scheme.
		9033.0[@] *4*	100[@] *4*	0.0	0$^+$	E1		B(E1)(W.u.)=0.0028 *2* Mult.: from γ(θ) and γ asymmetry in (γ,γ′).
9050	1	9050		0.0	0$^+$	D		E_γ,Mult.: from (α,α′γ), with Mult from αγ(θ).
9094.6		430[a]		8664.6	(3,4,5)			
9123.1	(1$^+$,2$^+$,3$^+$)	232[a]		8890.7	>5			
		459[a]		8664.6	(3,4,5)			
9295.3	1$^-$	9294.3	100	0.0	0$^+$	E1		B(E1)(W.u.)=0.00270 *+17−15* E_γ: other: 9300 from (α,α′γ) and ^{48}K β^- decay. Mult.: from γ(θ) and γ asymmetry in (γ,γ′) and αγ(θ) in (α,α′γ).
9295.7	(8$^-$)	405[a]		8890.7	>5			
9472.8	1$^-$	9471.8[@] *8*	100	0.0	0$^+$	E1		B(E1)(W.u.)=0.00241 *+22−19* Mult.: from γ(θ) and γ asymmetry in (γ,γ′).

$^{48}_{20}Ca_{28}$-17

Adopted Levels, Gammas (continued)

γ(^{48}Ca) (continued)

E_i(level)	J_i^π	E_γ[‡]	I_γ[#]	E_f	J_f^π	Mult.[e]	Comments
9545.72	1^-	9544.7[@] *2*	100	0.0	0^+	E1	B(E1)(W.u.)=0.00424 *+23−21* Mult.: from $\gamma(\theta)$ and γ asymmetry in (γ,γ').

† Additional information 19.
‡ Values with uncertainties are from (n,n′γ) and those without uncertainties are from level-energy differences for transitions reported in (p,p′γ) , unless otherwise noted. Note that values without uncertainties from (p,p′γ) are deduced from E(level) values reported in 1969Te03 only, while adopted E(level) values from (p,p′) are mostly from 1988Fu01 or average of all available measurements. Therefore, for those transitions, Eγ values quoted here have been re-deduced by the evaluator from the adopted level energies.
# From (n,n′γ), unless otherwise noted.
@ From (γ,γ').
& From β^- decay.
a From (^{48}Ca,^{48}Ca′γ).
b From (p,p′γ), except as noted.
c Very poor-fit and omitted in the fitting.
d Poor-fit and uncertainty multiplied by a factor of 3 in the fitting.
e D,Q or D+Q with δ are from $\gamma(\theta)$ in (n,n′γ) and electric or magnetic nature is from comparison to RUL where $T_{1/2}$ is available, unless otherwise noted.
f Multiply placed.
g Placement of transition in the level scheme is uncertain.

$^{48}_{20}Ca_{28}$-18

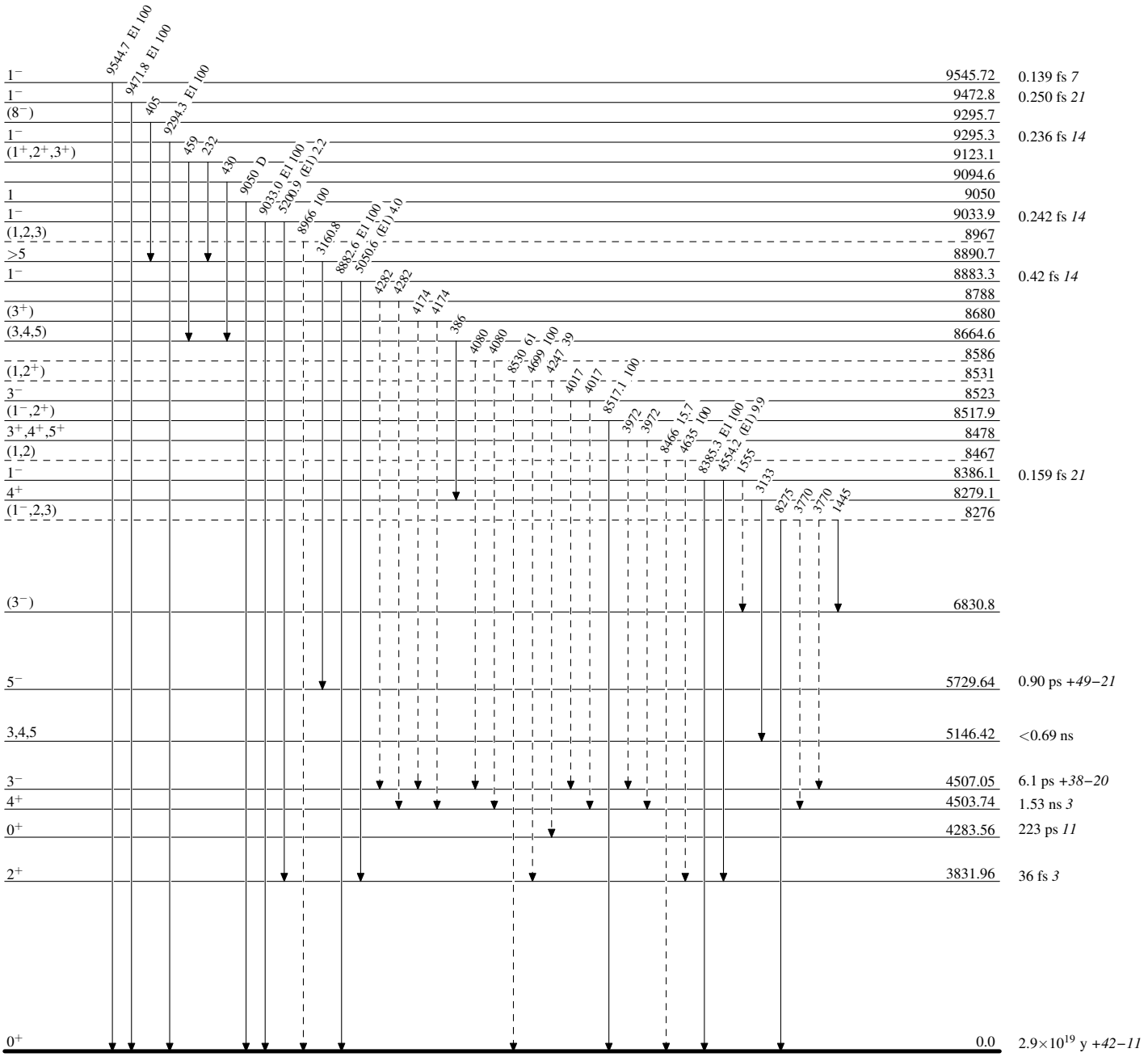
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



$^{48}_{20}Ca_{28}$

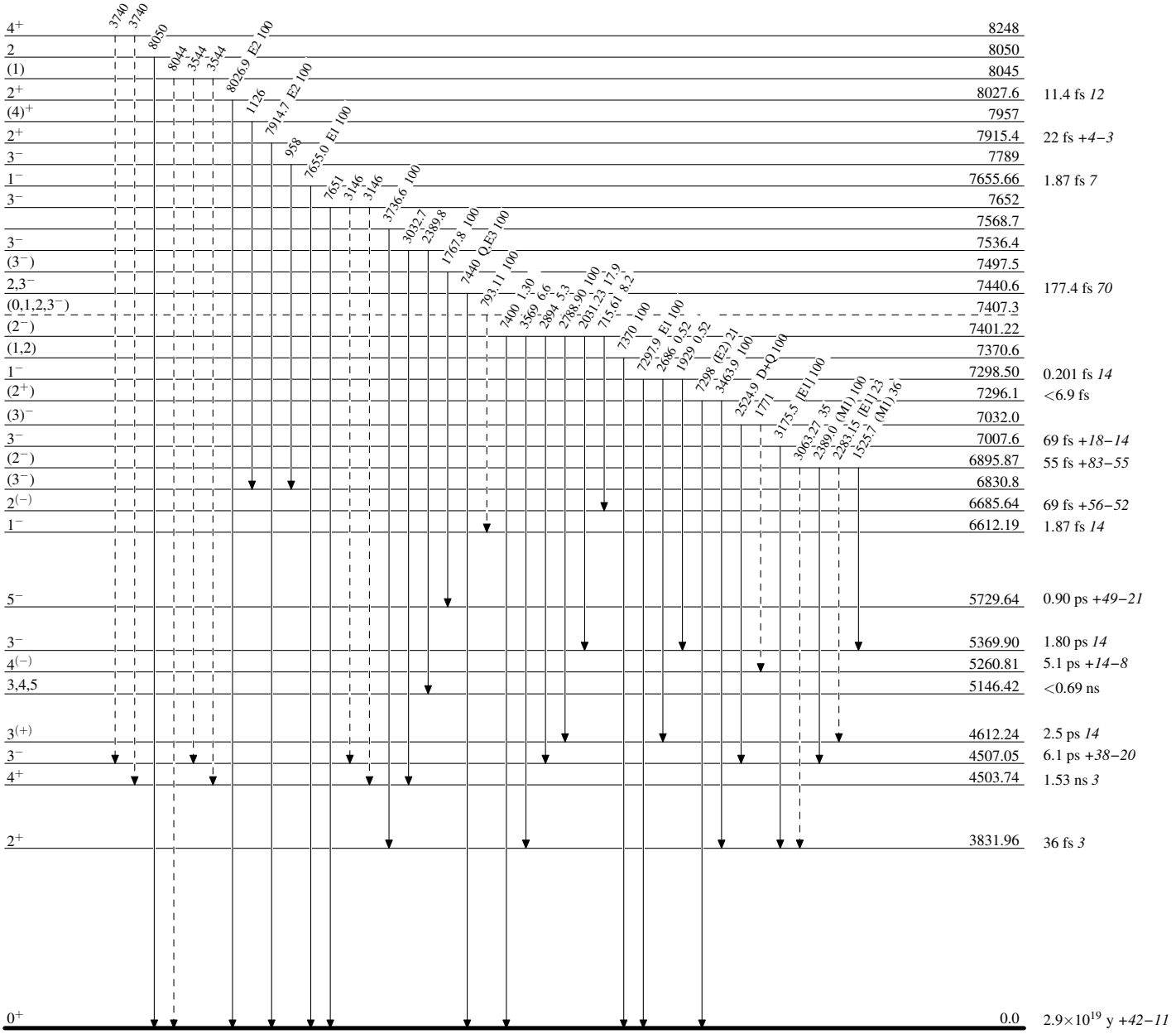
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



$^{48}_{20}Ca_{28}$

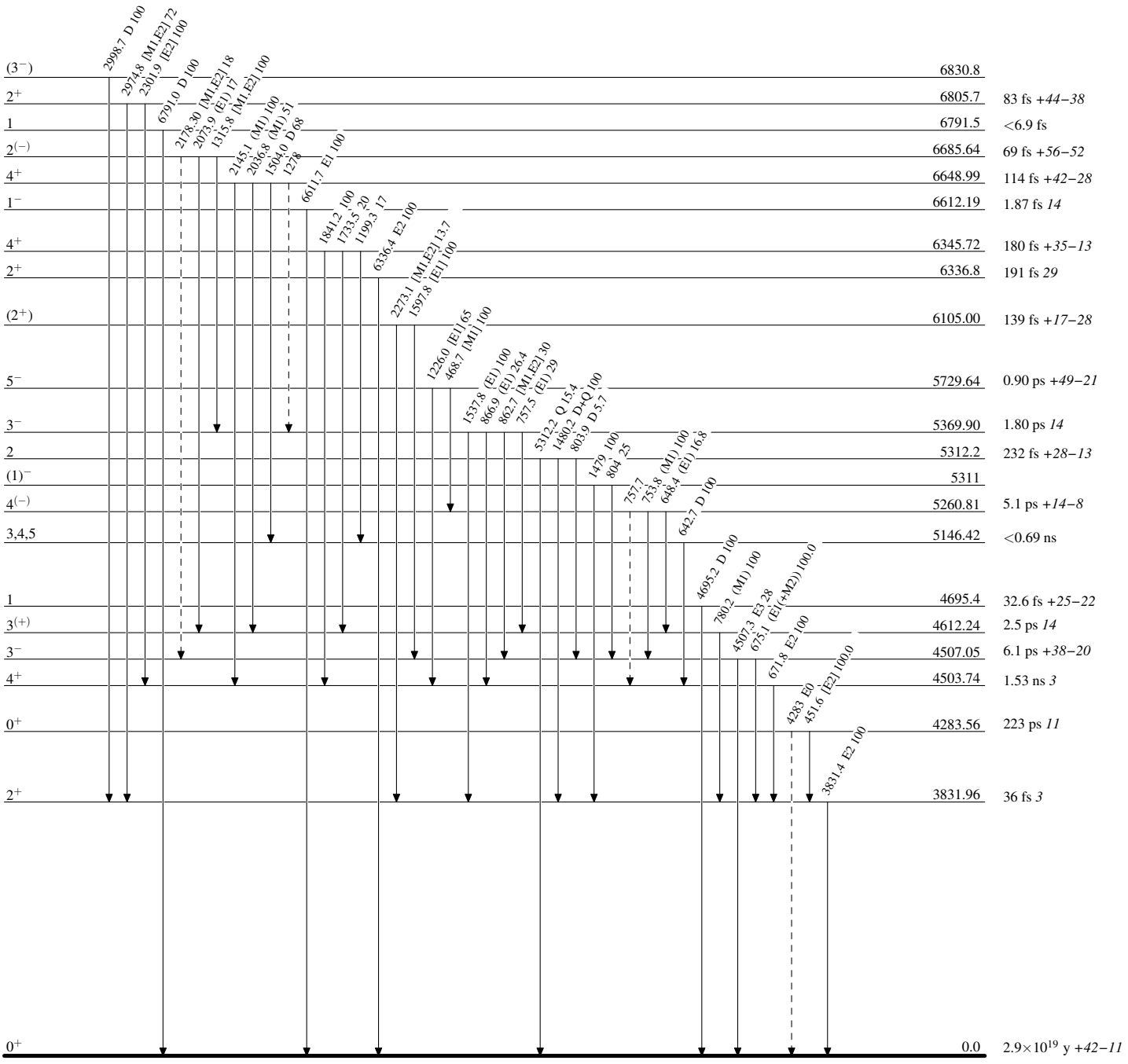
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

– – – – – – ► γ Decay (Uncertain)



$^{48}_{20}Ca_{28}$