Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen and Balraj Singh	NDS 157, 1 (2019)	15-Apr-2019

Q(β^-)=4958 *15*; S(n)=6360.8 *16*; S(p)=17266.7 *18*; Q(α)=−12241.2 *19* 2017Wa10
S(2n)=11507.2 *16*, S(2p)=31890 *310* (2017Wa10).
Mass measurement: 2012La05 (TOF-ICR resonance frequency ratios using TITAN Penning trap spectrometer at TRIUMF-ISAC facility).
Theory references: consult the NSR database (www.nndc.bnl.gov/nsr/) for 125 primary references for structure calculations.
Additional information 1.

^{50}Ca Levels

Cross Reference (XREF) Flags

A	^{50}K β^- decay (472 ms)	F	^{48}Ca(α,2p)
B	^{51}K β^-n decay (365 ms)	G	^{48}Ca(^{238}U,Xγ)
C	^{52}K β^-2n decay (110 ms)	H	^{208}Pb(^{48}Ca,Xγ)
D	^{1}H(^{50}Ca,P$'\gamma$)	I	^{238}U(^{48}Ca,Xγ)
E	^{48}Ca(t,p),(pol t,p)		

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$[a]	XREF	Comments
0.0	0$^+$	13.45 s *5*	ABCDEFGHI	%β^-=100 T$_{1/2}$: measured by 2017Ga25 from fit to the decay curves of 1519- and 1591-keV γ transitions, ^{50}Ca beam produced in Ta(p,X),E=500 MeV at TRIUMF, and counted using GRIFFIN array of Ge detectors. Others: 13.9 s *6* (1970Wa29, from decay curve for 257γ); 14 s *3* (1968Ch11, from decay curve for all γ rays); 9 s *2* (1964Sh14, decay curves for 72γ and 258γ). Nuclear rms charge radius: <r^2>$^{1/2}$=3.517 fm *7* (2013An02, evaluation). Measured δr^2(^{40}Ca,^{50}Ca)=0.291 fm^2 *3*(stat) *12*(syst) (2016Ga34, using COLLAPS at ISOLDE-CERN; see also 2017Ne04 review article on measurements at this facility). Previous measurement: 0.276 fm^2 *34* (1992Ve02, online collinear laser spectroscopy). Measured isotope shift $\delta\nu$(^{40}Ca,^{50}Ca)=1969.2 MHz *9*(stat) *47*(syst) (2016Ga34, using COLLAPS at ISOLDE-CERN). Previous measurement: 1951 MHz *9*(stat) *20*(syst) (1992Ve02, online collinear laser spectroscopy). Measurement of isotope shift and rms radii: 1992Ve02, 2017Ne04.
1026.72 *10*	2$^+$	66.5 ps *21*	ABCDEFGHI	J$^\pi$: E2 1026.7γ to 0$^+$; L(t,p)=2 from 0$^+$. T$_{1/2}$: recoil-distance Doppler-shift method (2009Va06) in ^{208}Pb(^{48}Ca,Xγ). Other: 68.6 ps *55* from DSAM in (^{50}Ca,p$'\gamma$).
3002.1 *5*	(2$^+$)	<0.69 ps	AB DEFGH	J$^\pi$: L(t,p)=(2). L(t,p)=(4) and L(α,2p)=(4) are also proposed but in the latter case L=2 does not seem ruled out in figure 32 of 1990Fi07.
3531.7 *4*	(1,2$^+$)		AB E	XREF: E(3519). J$^\pi$: 3531.7γ to 0$^+$. Note that J^π=0$^+$ is suggested in 1968Br01, 1967Gl08 and 1966Ve06 in theoretical analyses of (t,p) results for a 3519 level observed by 1967Bj06. It is possible two separate levels are populated near this energy.
3997.22 *21*	(3$^-$)	<0.69 ps	DEFGHI	J$^\pi$: L(t,p)=(3). Inconsistent with L(α,2p)=4, but L=3 comparison of $\sigma(\theta)$ data was not shown in figure 32 of 1990Fi07.
4035.7 *4*	(1,2$^+$)		AB D	J$^\pi$: 4035.6γ to 0$^+$.
4475.8 *5*	(0$^+$)		A E	J$^\pi$: L(t,p)=(0).
4515.04 *14*	(4$^+$)	<1.04 ps	DE GHI	J$^\pi$: strong population in ^{238}U(^{48}Ca,Xγ) suggests yrast 4$^+$ level. L(t,p)=(3) for a 4517 *15* group is inconsistent.
4830.6 *3*	(4)	<0.69 ps	E GHI	J$^\pi$: L(t,p)=(4); (4$^-$) proposed in ^{238}U(^{48}Ca,Xγ) from γ to (3$^-$).
4870 *5*	(2$^+$)		G	J$^\pi$: 4870γ to 0$^+$. J=1 less likely to be populated in high-spin reaction.
4886.3 *5*	(1$^-$)		A E	J$^\pi$: L(t,p)=(1); 4886.0γ to 0$^+$.

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Adopted Levels, Gammas (continued)

^{50}Ca Levels (continued)

E(level)[†]	Jπ[‡]	$T_{1/2}$[a]	XREF	Comments
4.97×10^3 *5*	(4$^+$&5$^-$)[#]		F	Jπ,E(level): L(α,2p)=4+5 for a possible doublet.
5043 *15*	(1$^-$)		E	Jπ: L(t,p)=(1).
5084.56 *25*	(4$^-$)[@]		I	
5109.88 *20*	(5$^-$)[@]	<0.69 ps	DE GHI	
5147.34 *17*	(5$^+$)[@]		I	
5168 *20*			E	
5281 *20*			E	
5362 *20*			E	
5434 *20*			E	
5516.92 *20*	(5$^-$)[@]		E I	Jπ: L(t,p)=(4), but data were insufficient to get a reliable L value.
5576 *20*			E	Jπ: L(t,p)=(4), but data were insufficient to get a reliable L value.
6519 *8*			A	%n≈100 Additional information 2.
6869.27 *25*	(7$^-$)[@]		I	
7039 *36*			A	%n≈100 Additional information 3.
7269 *46*			A	%n≈100 Additional information 4.
7309 *51*			A	%n≈100 Additional information 5.
7619 *66*			A	%n≈100 Additional information 6.
7999 *87*			A	%n≈100 Additional information 7.
8249 *97*			A	%n≈100 Additional information 8.
8.38×10^3 *5*	(7$^-$)[#]		F	
8.81×10^3 *12*	(0$^-$,1$^-$)[&]		A	%n≈100 Additional information 9.
8.98×10^3 *5*	(7$^-$)[#]		F	
9239 *46*	(0$^-$,1$^-$)[&]		A	%n≈100 Additional information 10.
9779 *72*	(0$^-$,1$^-$)[&]		A	%n≈100 Additional information 11.
9.80×10^3 *5*	(6$^+$)[#]		F	Jπ: 8$^+$ is not completely ruled out.
10.33×10^3 *5*	(8$^+$)[#]		F	Jπ: 6$^+$ is not completely ruled out.
10430 *36*	(0$^-$,1$^-$)[&]		A	%n≈100 Additional information 12.
1.055×10^4 *11*	(0$^-$,1$^-$)[&]		A	%n≈100 Additional information 13.
11059 *36*	(0$^-$,1$^-$)[&]		A	%n≈100 Additional information 14.
11479 *52*	(0$^-$,1$^-$)[&]		A	%n≈100 Additional information 15.

[†] For levels populated in γ-ray studies, values are from least-squares to γ-ray energies. For levels populated in particle-reaction studies, averages are taken when possible.

[‡] From DWBA analysis of σ(θ) in (t,p), except as noted. See (t,p) for additional tentative J^π assignments. For L(t,p) and L(α,2p) transfer reactions, target $J^\pi=0^+$. Most L(t,p) are considered by the evaluators as tentative values due either to disagreements with

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Adopted Levels, Gammas (continued)

^{50}Ca Levels (continued)

other reactions or to weak populations of levels.
[#] From CCBA and DWBA analyses in (α,2p).
[@] Tentative assignments in ^{238}U(^{48}Ca,Xγ) based on γ-decay pattern and possible model predictions. No supporting data are available for transition multipolarity assignments.
[&] From allowed β transition (log *ft*=4.1 to 4.9) from $0^{(-)}$ parent state.
[a] From RDDS method in ^{208}Pb(^{48}Ca,Xγ), unless otherwise stated.

γ(^{50}Ca)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[#]	Comments
1026.72	2^+	1026.7 *1*	100	0.0	0^+	E2	B(E2)(W.u.)=0.68 *2* E_γ: weighted average of 1027.0 *5* from ^{50}K β^- decay (472 ms), 1026.2 *3* from (^{238}U,Xγ), and 1026.7 *1* from (^{48}Ca,Xγ). Others: 1027 *1* from ^{51}K β^-n decay (365 ms), 1027 *1* from ^{52}K β^-2n decay (110 ms), and 1028 *2* from (^{50}Ca,p$'\gamma$). Mult.: $\gamma(\theta)$ and linear polarization in ^{208}Pb(^{48}Ca,Xγ).
3002.1	(2^+)	1975.3 *5*	100	1026.72	2^+	(D)	E_γ: from β^- decay. Other: 1976 *1* from β^-n decay; 1978.2 *6* in ^{48}Ca(^{238}U,Xγ) is discrepant, possibly due to Doppler-shift effects. It is possible that 1978,2γ defined a level separate from 3002, (2^+), but there is no strong evidence for its existence.
3531.7	$(1,2^+)$	2504.5 *8*	100 *13*	1026.72	2^+		E_γ: weighted average of 2504.9 *5* from ^{50}K β^- decay (472 ms) and 2503 *1* from ^{51}K β^-n decay (365 ms). I_γ: from ^{50}K β^- decay . Other: 100 *17* from β^-n decay.
		3531.7 *4*	92 *13*	0.0	0^+		E_γ: weighted average of 3531.8 *5* from ^{50}K β^- decay (472 ms) and 3530 *2* from ^{51}K β^-n decay (365 ms). I_γ: from ^{50}K β^- decay . Other: 133 *17* from β^-n decay.
3997.22	(3^-)	2970.3 *3*	100	1026.72	2^+	D	E_γ: weighted average of 2964 *8* from (^{50}Ca,p$'\gamma$), 2971.4 *6* from (^{238}U,Xγ), and 2970.2 *2* from (^{48}Ca,Xγ).
4035.7	$(1,2^+)$	3008.8 *5*	60 *4*	1026.72	2^+		E_γ: weighted average of 3008.9 *5* from ^{50}K β^- decay and 3008 *2* from ^{51}K β^-n decay. I_γ: from ^{50}K β^- decay. Others: 60 *20* from ^{51}K β^-n decay and 75 *25* from (^{50}Ca,p$'\gamma$).
		4035.6[‡] *5*	100 *6*	0.0	0^+		E_γ: weighted average of 4035.6 *5* from ^{50}K β^- decay and 4035 *2* from ^{51}K β^-n decay. Other: 4030 *18* from (^{50}Ca,p$'\gamma$). I_γ: from ^{50}K β^- decay. Others: 100 *20* from ^{51}K β^-n decay, and 100 *25* from (^{50}Ca,p$'\gamma$).
4475.8	(0^+)	3449.0[‡] *5*	100	1026.72	2^+		
4515.04	(4^+)	518.4 *7*	2 *1*	3997.22	(3^-)		
		3488.2 *1*	100	1026.72	2^+	(E2)	E_γ: others: 3482 *14* from (^{50}Ca,p$'\gamma$) and 3488.4 *8* from (^{238}U,Xγ).
4830.6	(4)	833.4 *2*	100	3997.22	(3^-)	(D)	E_γ: weighted average of 833.9 *5* from (^{238}U,Xγ) and 833.3 *2* from (^{48}Ca,Xγ).
4870	(2^+)	4870 *5*		0.0	0^+		E_γ: from (^{238}U,Xγ) only.
4886.3	(1^-)	4886.0[‡] *5*	100	0.0	0^+		
5084.56	(4^-)	1087.2 *3*	100	3997.22	(3^-)		
5109.88	(5^-)	594.9 *2*	100 *6*	4515.04	(4^+)	D	E_γ: weighted average of 603 *11* from (^{50}Ca,p$'\gamma$), 595.5 *3* from (^{238}U,Xγ), and 594.8 *1* from (^{48}Ca,Xγ).
		1112.6 *2*	6.8 *14*	3997.22	(3^-)		
5147.34	(5^+)	632.3 *1*	100	4515.04	(4^+)		

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Adopted Levels, Gammas (continued)

$\gamma(^{50}Ca)$ (continued)

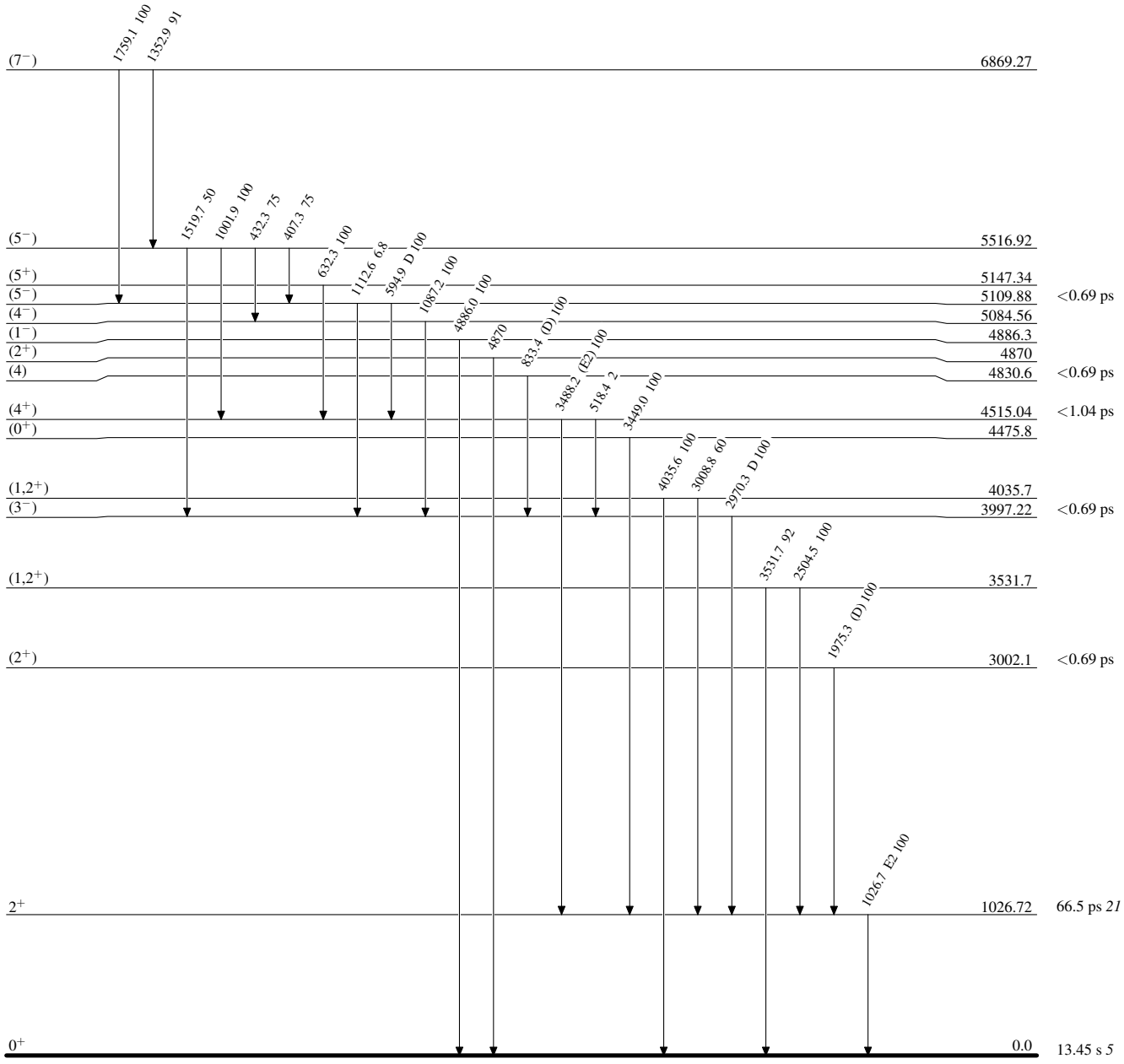
E_i(level)	J_i^π	E_γ †	I_γ †	E_f	J_f^π
5516.92	(5^-)	407.3 *2*	75 *13*	5109.88	(5^-)
		432.3 *2*	75 *13*	5084.56	(4^-)
		1001.9 *2*	100 *13*	4515.04	(4^+)
		1519.7 *5*	50 *13*	3997.22	(3^-)
6869.27	(7^-)	1352.9 *3*	91 *18*	5516.92	(5^-)
		1759.1 *2*	100 *9*	5109.88	(5^-)

† From $^{238}U(^{48}Ca,X\gamma)$, unless stated otherwise.
‡ From β^- decay.
# From $\gamma(\theta)$ in $^{208}Pb(^{48}Ca,X\gamma)$, unless otherwise stated.

Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level



$^{50}_{20}Ca_{30}$