Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen and Balraj Singh	NDS 190,1 (2023)	20-Jun-2023

Q(β^-)=3108.2 *16*; S(n)=8735 *6*; S(p)=15800 *60*; Q(α)=−12260 *4* 2021Wa16
S(2n)=14393 *6*, S(2p)=29613 *3* (2021Wa16).
Other measurements:
$T_{1/2}$ of ^{44}Ar: 1970Hu11, 1969La16.
1971Ar32: ^{232}Th(^{40}Ar,X), E=290 MeV, measured fragments isotopic yields.
1997Li15: reaction cross sections and radii for f-p shell nuclei.
1999Ai02: ^{44}Ar beam from ^{55}Mn fragmentation, Si(^{44}Ar,X) studied.
2001Sc01: ^{1}H(^{44}Ar,^{44}Ar′) E=33.0 MeV and ^{44}Ar(p,p′) E=33.2 MeV, measured cross section, deduced B(E2).
2001Vo09: ^{48}Ca(p,pα), populated ground state of daughter nucleus.
2004De41: ^{nat}Cu(^{7}Li,X), E=35 MeV, measured cross-section.
2006Ro34: ^{2}H(^{48}Ca,X), measured production cross-section.
Mass measurement: 2003Bl17.
Theoretical structure calculations:
2021Pe14: calculated potential energy curves as function of deformation parameter β_2 using constrained axial RHB method.
2021Su18: calculated potential energy surfaces, occupation numbers for ground state in (β,γ) plane, energies, spins, B(E2) and quadrupole moments of low-lying positive-parity levels using antisymmetrized molecular dynamics (AMD) with Gogny D1S density functional.
2013Wa05: calculated single-particle levels, J^π occupational probabilities, proton density distributions using Skyrme-Hartree-Fock approach.
2011Ka03: calculated energy, B(E2) and quadrupole moment of first 2^+ state using shell model with the extended pairing plus quadrupole-quadrupole forces.
2009Ro08: theory: calculated levels, J^π, g factors, B(E2), configurations using shell model with WBT and SDPF-U interactions.
1997Re04: calculated 2^+ levels using shell model.
Other theoretical calculations: 26 references for structure and one for radioactive decays retrieved from the NSR database (www.nndc.bnl.gov/nsr/) are listed in document records which can be accessed via web-based ENSDF database.
Additional information 1.

^{44}Ar Levels

Cross Reference (XREF) Flags

A	^{44}Cl β^- decay (0.54 s)	E	^{208}Pb(^{48}Ca,Xγ)
B	^{45}Cl β^-n decay	F	C(^{46}K,pnγ)
C	^{48}Ca(^{3}He,^{7}Be)	G	Coulomb excitation
D	^{48}Ca(^{48}Ca,^{44}Arγ)		

E(level)†	J^π‡	$T_{1/2}$#	XREF	Comments
0.0	0^+	11.87 min *5*	ABCDEFG	%β^-=100 Evaluated rms charge radius ($<r^2>)^{1/2}$=3.4454 fm *46* (2013An02). Evaluated change in charge radius $\delta<r^2>$(^{44}Ar−^{38}Ar)=+0.289 fm^2 *9* (2013An02). $T_{1/2}$: from 1970Hu11. Other: 14.0 min *15* (1969La16). Measured rms charge radius ($<r^2>)^{1/2}$=3.4454 fm *22* from $\delta<r^2>$(^{44}Ar−^{38}Ar)=+0.289 fm^2 *9*(stat) *81*(syst) (2008Bl01, laser spectroscopy).
750? *30*	(0^+)		C	E(level): Shell-model calculations predict a 0^+ level at 830 (1976Cr03). But this level is considered as uncertain (by the evaluators) since recent γ-ray studies (1999WiZX,1999Wa21) show the first excited state at 1158 with $J^\pi=2^+$. If this state exists, a weak 408 keV γ-ray could have missed since it would have an intensity ≤10% of the 1158 keV γ-ray.

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{44}Ar Levels (continued)

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$[#]	XREF	Comments
1158.14 *11*	2$^+$	3.80 ps *+49−33*	AB DEFG	Q=−0.083 *30* (2009Zi01) B(E2)↑=0.0360 *+34−41* XREF: F(1110). B(E2)↑,Q: from Coulomb Excitation (2009Zi01). Value of quadrupole moment not listed in 2021StZZ, 2016St14 and 2014StZZ evaluations. J$^\pi$: strong Coulomb excitation from 0$^+$ g.s. T$_{1/2}$: weighted average of 4.1 ps *14* from RDDS in (^{48}Ca,Xγ) and 3.77 ps *+49−33* deduced from B(E2)↑ measured in Coulomb excitation. B(E2)↑: weighted average of 0.0345 *41* (1996Sc31) and 0.0378 *+34−55* (2009Zi01) from Coulomb excitation.
1610 *30*	(2$^+$)		C	
1.78×10^3? *8*			F	
2010.93 *14*	(2$^+$)	1.53 ps *+20−17*	AB G	B(E2)↑=0.0023 *2* B(E2)↑: from Coulomb Excitation (2009Zi01). J$^\pi$: level Coulomb excited from 0$^+$ g.s. T$_{1/2}$: deduced by evaluators from adopted B(E2).
2746.37 *30*	(4$^+$)	2.7 ps *+25−20*	A DEF	XREF: F(2610). J$^\pi$: strong γ branch to 0$^+$ suggests J=1,2. If the 2610 *160* level from (^{46}K,pnγ) decaying by a 1500 *80* γ is the same as the 2746 level in ^{44}Cl β^- decay, then J^π=4$^+$ as proposed by 1999Wa21 is less likely by a strong γ to 0$^+$. It is possible that either there are two different levels near this energy or that the 2747γ is incorrectly placed in the decay study.
2976.25 *17*			A	
3439.4 *11*	(6$^+$)	>27.7 ps	CDE	XREF: C(3480).
3980 *50*			C	
4430 *40*			C	
4807.68 *28*			A	
5352.22 *29*			A	

[†] From a least-squares to Eγ data for levels populated in γ-ray studies. Others are from reaction studies. Where ΔEγ is not available, it is assumed to be 0.5 keV for Eγ quoted to nearest tenth keV and 1.0 keV for Eγ quoted to nearest keV. In the fitting procedure, ΔEγ for 2010.18γ has been increased to 0.5 keV from 0.18 keV to decrease the reduced χ^2 to 2.68 from 3.92.

[‡] Predicted from Shell Model calculations (1999Wa21,2000Fo03,1976Cr03) and systematics of even-even nuclei, unless otherwise noted.

[#] From the differential recoil distance Doppler shift (RDDS) method in ^{208}Pb(^{48}Ca,Xγ), unless otherwise noted.

γ(^{44}Ar)

E$_i$(level)	J$_i^\pi$	E$_\gamma$[†]	I$_\gamma$[†]	E$_f$	J$_f^\pi$	Mult.	Comments
1158.14	2$^+$	1158.11 *12*	100	0.0	0$^+$	E2	B(E2)(W.u.)=7.8 *+7−9* E$_\gamma$: other: 1110 *80* from (^{46}K,pnγ).
1.78×10$^{3?}$		1780[‡#] *80*		0.0	0$^+$		
2010.93	(2$^+$)	852.77 *10*	100.0 *21*	1158.14	2$^+$	[M1,E2]	If M1, B(M1)(W.u.)=0.0138 *+17−16*. If E2, B(E2)(W.u.)=53 *+7−6*.
		2010.18 *18*	68.8 *21*	0.0	0$^+$	[E2]	B(E2)(W.u.)=0.50 *6* E$_\gamma$: other: 2010.6 from ^{45}Cl β^-n decay with Iγ=60. Poor fit; level-energy difference=2010.93 *14*.
2746.37	(4$^+$)	1588.1 *3*	100 *8*	1158.14	2$^+$	[E2]	B(E2)(W.u.)=1.5 *+20−8* E$_\gamma$: other: 1500 *80* from (^{46}K,pnγ).
		2747.0[#] *8*	47 *8*	0.0	0$^+$	[E4]	

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

$\gamma(^{44}Ar)$ (continued)

E_i(level)	J_i^π	E_γ †	I_γ †	E_f	J_f^π	Mult.	Comments
2976.25		965.32 *12*	100 *7*	2010.93	(2^+)		
		1817.7 *3*	47 *5*	1158.14	2^+		
3439.4	(6^+)	693	100	2746.37	(4^+)	[E2]	B(E2)(W.u.)<14 E_γ,I_γ: from ^{208}Pb(^{48}Ca,Xγ).
4807.68		2796.0 *4*	100	2010.93	(2^+)		
		3649.8		1158.14	2^+		
		4808.0		0.0	0^+		
5352.22		2375.6 *3*	100 *6*	2976.25			
		3338.4 *15*	41 *8*	2010.93	(2^+)		Level-energy difference=3341.15 *27*.
		4195.0		1158.14	2^+		Level-energy difference=4193.87 *27*.

† From ^{44}Cl β^- decay, unless otherwise stated.
‡ From C(^{46}K,pnγ).
# Placement of transition in the level scheme is uncertain.

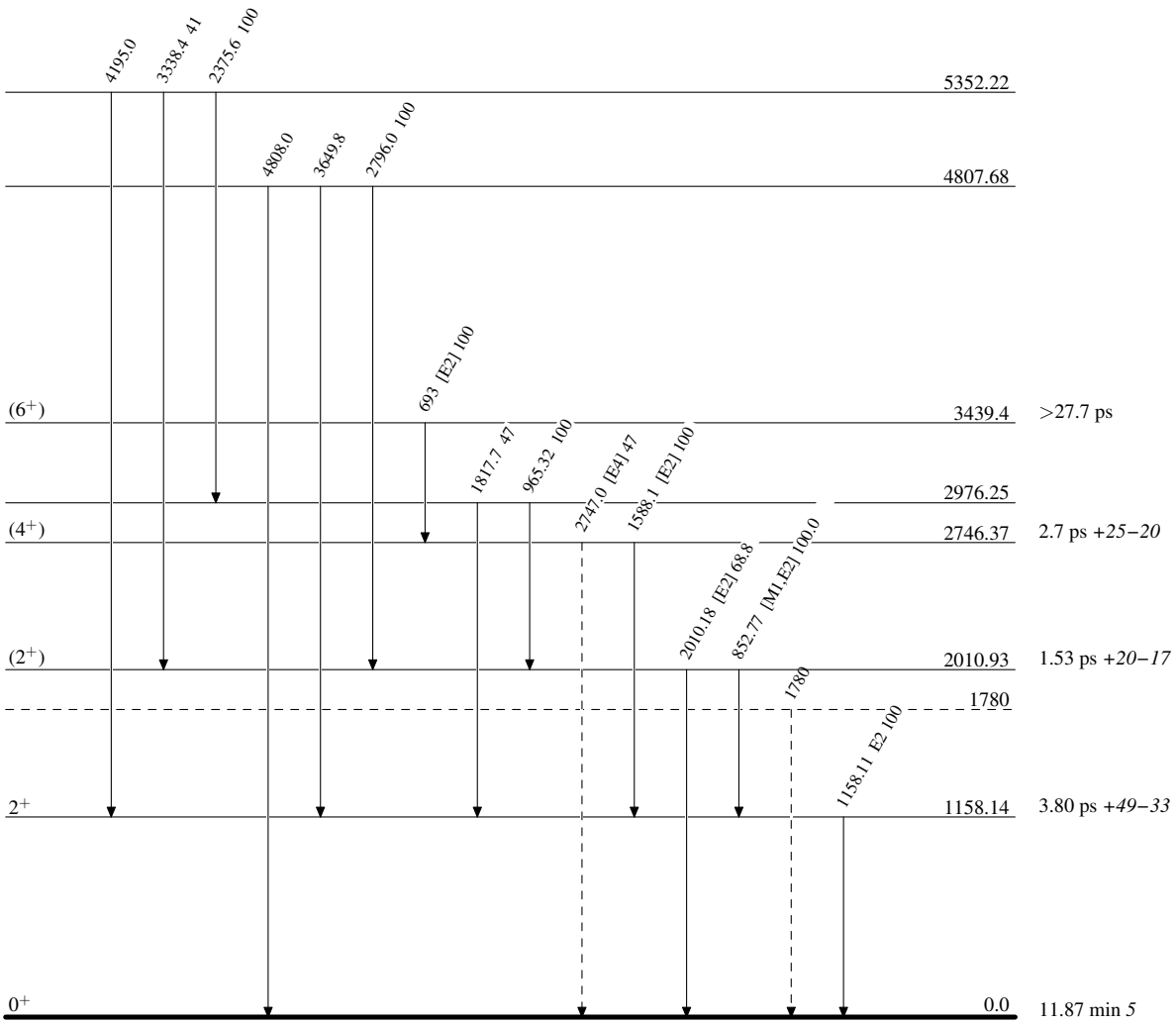
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



$^{44}_{18}Ar_{26}$