Nuclear Data Sheets for A = 43^{*}

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Abstract: The experimental data are evaluated for known nuclides of mass number A=43 (Al, Si, P, S, Cl, Ar, K, Ca, Sc, Ti, V, Cr). Detailed evaluated level properties and related information are presented, including adopted values of level and γ -ray energies, decay data (energies, intensities and placement of radiations), and other spectroscopic data. This work supersedes earlier full evaluations of A=43 published by 2001Ca24 and 1990En08 (also 1978En04, and 1998En04 update).

No excited states are known in ^{43}Al , ^{43}Si and ^{43}Cr . Only one excited state is known in ^{43}V which is the probable the Isobaric Analog State (IAS) of ^{43}Cr ground state. Information for ^{43}P , ^{43}S , ^{43}Cl , ^{43}Ar and ^{43}Ti is limited; there is either no decay data available or the decay schemes are incomplete in view of large Q values and known excitations much lower than allowed by Q values. The ^{43}K , ^{43}Ca and ^{43}Sc nuclides remain the most extensively studied from many different reactions and decays.

Cutoff Date: Literature available up to March 31, 2015 has been included. Main bibliographic source was the NSR database (2011Pr03) at Brookhaven laboratory webpage: www.nndc.bnl.gov/nsr/

General Policies and Organization of Material: see <http://www.nndc.bnl.gov/nds/NDSPolicies.pdf>.

General Comments: The statistical analysis of γ -ray data and deduced level schemes is carried out through computer codes available at NNDC, BNL website: www.nndc.bnl.gov. The direct feedings to excited states in β^- and ϵ decays have generally been computed from $I(\gamma+ce)$ intensity balances at each level; the associated $\log ft$ values are calculated using LOGFT code. The Q values and particle-separation energies have been adopted from 2012Wa38 (AME-12). In cases where weighted averaging procedures have been used, the assigned uncertainty is generally not lower than the lowest uncertainty given in a measurement. Nuclear charge radii have been adopted from 2013An02 evaluation. Moments are from 2014StZZ and 2013StZZ whenever possible. Theoretical total conversion coefficients are from BrIcc code (2008Ki07) for frozen-orbit option with an implicit uncertainty of 1.4% when not stated

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Mirror States (T=1/2) of ^{43}Sc and ^{43}Ti

E(^{43}Sc)	J π	E(^{43}Ti)	J π	E(^{43}Sc)	J π	E(^{43}Ti)	J π
0	7/2-	0	7/2-	1830.33	11/2-	1857.7	(11/2-)
151.79	3/2+	313.0	(3/2+)	2988.12	15/2-	2951.7	(15/2-)
472.60	3/2-	475		3123.73	19/2-	3066.40	(19/2-)

Isospin Quadruplet States (T=3/2) in A=43 nuclei

E(^{43}Ca)	J π	E(^{43}Sc)	J π	E(^{43}Ca)	J π	E(^{43}Sc)	J π
0	7/2-	4276	7/2-	2611.1	1/2-	6685.1	1/2-
1957.4	1/2+	6223	1/2+			6709	1/2-
2046.21	3/2-	6146	1/2-, 3/2-				

Isospin Sextuplet States (T=5/2) in A=43 nuclei

E(^{43}K)	J π	E(^{43}Ca)	J π	E(^{43}K)	J π	E(^{43}Ca)	J π
0	3/2+	7990	(3/2)+	975.32	3/2-	8993	1/2-, 3/2-
561.20	1/2+	8590	1/2+	1109.93	3/2+	9145	3/2+, 5/2+
738.30	7/2-	8767	5/2-, 7/2-	2451	1/2+	10485	1/2+

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NUCLEAR DATA SHEETS

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Skeleton Scheme for A=43

Skeleton Scheme for A=43 (continued)

S(n) 16610^{SY}

S(α) 6920^{SY}

S(n) 18370^{SY}

S(p) 1970^{SY}

S(α) 6170⁵⁰

S(n) 12138.3¹⁹

S(p) 4489⁷
S(α) 4463⁷

S(p) 10675.76²⁵

S(n) 7932.89¹⁷
S(α) 7592⁵

$7/2-$ 0.0

43Ca_{23}

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Ground-State and Isomeric-Level Properties for A=43

Nuclide	Level	$J\pi$	$T_{1/2}$	Decay Modes
⁴³ Al	0.0		>170 ns	%β ⁻ =?; %β ⁻ n=?
⁴³ Si	0.0		>60 ns	%β ⁻ =?; %β ⁻ n=?; %β ⁻ 2n=?
⁴³ P	0.0	1/2+	36.5 ms 15	%β ⁻ =100; %β ⁻ n=100; %β ⁻ 2n=?
⁴³ S	0.0	(3/2-)	265 ms 15	%β ⁻ =100; %β ⁻ n=40 10
⁴³ Cl	0.0	(1/2+)	3.13 s 9	%β ⁻ =100
⁴³ Ar	0.0	5/2(-)	5.37 min 6	%β ⁻ =100
⁴³ K	0.0	3/2+	22.3 h 1	%β ⁻ =100
⁴³ Ca	0.0	7/2-	stable	
⁴³ Sc	0.0	7/2-	3.891 h 12	%ε+%β ⁺ =100
	151.79	3/2+	438 μs 7	%IT=100
⁴³ Ti	0.0	7/2-	509 ms 5	%ε+%β ⁺ =100; %εp=?
⁴³ V	0.0		79.3 ms 24	%ε+%β ⁺ =100; %εp=?
⁴³ Cr	0.0	(3/2+)	21.2 ms 7	%εp=79.3 30; %ε2p=11.6 10; %EC3P=0.13 +18-8
⁴⁴ S	0.0	0+	100 ms 1	%β ⁻ n=18 3; ...
⁴⁴ Cr	0.0	0+	42.8 ms 6	%εp=12 2; ...
⁴⁵ Fe	0.0	(3/2+)	2.4 ms 3	%2p=70 4; ...

Adopted Levels

$Q(\beta^-)=24840$ SY; $S(n)=960$ SY; $S(p)=23340$ CA; $Q(\alpha)=-21730$ CA 2012Wa38,1997Mo25.

Estimated uncertainties: $\Delta Q(\beta^-)=\Delta S(n)=920$ (2012Wa38).

$S(2n)=2090$ 920, $Q(\beta^-n)=23310$ 860 (syst,2012Wa38). $S(2p)=53620$ (calculated,1997Mo25).

$Q(\beta^-)$ and $S(n)$ from 2012Wa38; $S(p)$ and $Q(\alpha)$ from 1997Mo25.

First possible identification of ^{43}Al nuclide by 2007Ba71.

2007Ba71: $W(^{48}\text{Ca},X\gamma)$ $E=141$ MeV/nucleon beam from the National Superconducting Cyclotron Laboratory (NSCL). The fragments were separated with the A1900 fragment separator. Isotopic identification by multiple ΔE signals, magnetic rigidity, total energy and time-of-flight analysis. Detectors: plastic scintillators, parallel-plate avalanche counters (PPACs) and silicon PIN diodes.

2008Ad08: calculated production cross section for $^{181}\text{Ta}(^{48}\text{Ca},X)$: 40 fb.

 ^{43}Al Levels

E(level)	$T_{1/2}$	Comments
0.0?	>170 ns	<p>$\% \beta^-=?$; $\% \beta^-n=?$; $\% \beta^-2n=?$</p> <p>One event was assigned to ^{43}Al with a probability of 0.0024 that this event was due to possible contribution from the neighboring ^{42}Al.</p> <p>E(level): the observed event is assumed to correspond to the g.s. of ^{43}Al.</p> <p>$T_{1/2}$: limiting value estimated from time-of-flight of ≈ 170 ns (Fig. 3 in 2007Ba71) at NSCL facility.</p> <p>Actual half-life is expected to be much longer as suggested by 1.2 ms from calculations by 1997Mo25.</p> <p>$J\pi$: $5/2+$ (syst,1997Mo25).</p>

Adopted Levels

$Q(\beta^-)=18420$ SY; $S(n)=1530$ SY; $S(p)=25030$ SY; $Q(\alpha)=-21600$ SY 2012Wa38.

Estimated uncertainties: $\Delta Q(\beta^-)=700$, $\Delta S(n)=780$, $\Delta S(p)=840$, $\Delta Q(\alpha)=790$ (2012Wa38).

$S(2n)=5160$ 700, $Q(\beta^-n)=14020$ 630 (syst,2012Wa38).

$S(2p)=50140$ (calculated,1997Mo25).

First identification of ^{43}Si nuclide by 2002No11.

2007Ta15: $E=142$ MeV/nucleon ^{48}Ca beam from the coupled cyclotron facility at the NSCL. Targets of 724 mg/cm² ^9Be or 1111 mg/cm² natW. Reaction products separated by the A1900 fragment separator and detected in a plastic scintillator at the focal plane. Measured production cross section, 5 pb ².

2002No11: ^{43}Si seen in reaction: $\text{Ta}(^{48}\text{Ca},X)$ $E=64$ MeV/nucleon. Reaction fragments analyzed by RIPS recoil fragment separator at RIKEN facility. Identification by measurements of energy loss, total kinetic energy, time-of-flight and magnetic rigidity for each fragment. Four events were observed.

2008Ad08: calculated production cross section for natW($^{48}\text{Ca},X$): 4.4 pb.

 ^{43}Si Levels

E(level)	$T_{1/2}$	Comments
0.0	>60 ns	<p>$\% \beta^-=?$; $\% \beta^-n=?$; $\% \beta^-2n=?$</p> <p>Four events were assigned to ^{43}Si by 2002No11. Production $\sigma=5$ pb ² (2007Ta15).</p> <p>E(level): the observed ^{43}Si fragments are assumed to correspond to the g.s.</p> <p>$T_{1/2}$: limiting value from time-of-flight in 2002No11. Actual half-life is expected to be much longer as suggested by systematics value of 15 ms (2012Au07) and calculated value of 13.5 ms (1997Mo25).</p> <p>$J\pi$: systematics: $3/2^-$ (2012Au07,1997Mo25).</p>

Adopted Levels, Gammas

$Q(\beta^-)=16880\ 370$; $S(n)=4400\ 430$; $S(p)=19170\ SY$; $Q(\alpha)=-18740\ SY$ 2012Wa38.

Estimated uncertainties: $\Delta S(p)=\Delta Q(\alpha)=620$ (2012Wa38).

$S(2n)=6480\ 380$, $S(2p)=43790\ 700$ (syst), $Q(\beta^-n)=14250\ 370$, (2012Wa38).

First identification of ^{43}P nuclide by 1989Gu03.

^{43}P isotope identified in $^{181}\text{Ta}(^{48}\text{Ca},X)$ $E=55$ MeV/nucleon (1989Gu03) and in $^{64}\text{Ni}(^{48}\text{Ca},X)$ $E=60$ MeV/nucleon (1995So03, GANIL facility), followed by measurement of fragment spectra. Measured β^-n .

2004Gr20 (also 2003Gr22): ^{43}P produced in $^9\text{Be}(^{48}\text{Ca},X)$ at $E=60$ MeV/nucleon, LISE3 spectrometer at GANIL, isotopic identification by energy loss, time-of-flight and magnetic rigidities, double-sided Si strip (DSSD) detectors for residues. Measured (β^-) (residues) time correlations and half-life using scintillation detectors for β^- -rays.

Mass measurement: 2000Sa21 (also 2001Sa72).

2006Fr13 (also 2005Fr19): see $^9\text{Be}(^{44}\text{S},^{43}\text{P}\gamma)$ dataset.

Mean-square radius from energy-integrated cross sections: 2006Kh08.

 ^{43}P Levels**Cross Reference (XREF) Flags**

A $^9\text{Be}(^{44}\text{S},^{43}\text{P}\gamma)$

E(level) [†]	$J\pi^\ddagger$	XREF	$T_{1/2}$	Comments
0.0	1/2+	A	36.5 ms 15	$\beta^-n=100$; $\beta^-n=100$; $\beta^-2n=?$ Measured mean-square radius (r^2_0)=1.77 fm ² 28 (2006Kh08). $\pi 2s_{1/2}$ orbital (2006Fr13,2008Ri04). $T_{1/2}$: from $\beta(^{43}\text{P})$ timing correlations followed up to 400 ms (2004Gr20, measurement at GANIL). Others: 33 ms 3 (1995So03, earlier measurement at GANIL), 1999YoZW. Weighted average of the two values (from 2004Gr20 and 1995So03) is 35.8 ms 15. β^-n : from 1995So03. Other: 1999YoZW. $\pi 1d_{3/2}$ orbital (2006Fr13,2008Ri04).
184 1	3/2+	A		
845 3	(5/2+)	A		
1009 5	(5/2+)	A		
1095 6	(5/2+)	A		
1774 8	(5/2+)	A		
2035 11	(5/2+)	A		

[†] From least-squares fit to $E\gamma$ data.

[‡] From comparisons of experimental data with shell-model calculations (2008Ri04). For g.s., 184, 1009 and 1095 levels, parallel-momentum distributions give $L=0$ for g.s., and $L=2$ for all others in a proton-removal reaction.

 $\gamma(^{43}\text{P})$

E(level)	$E\gamma^\dagger$	$I\gamma^\dagger$
184	184 1	100
845	661 4	100 13
	845 4	34 9
1009	825 5	100
1095	911 6	100
1774	765 6	100
2035	1018 [‡] 6	71 14
	1851 11	100 14

[†] From 2008Ri04.

[‡] Placement of transition in the level scheme is uncertain.

$^9\text{Be}(^{44}\text{S}, ^{43}\text{P}\gamma)$ 2008Ri04,2006Fr13

One-proton knockout reaction.

2008Ri04: $E=91.7$ MeV/nucleon ^{44}S beam was produced by the Coupled Cyclotron facility at NSCL by fragmentation of 140 MeV/nucleon ^{48}Ca beam on a 705 mg/cm^2 ^9Be fragmentation target and incident on a ^9Be 376 mg/cm^2 reaction target. Fragments were separated by the A1900 fragment separator and S800 magnetic spectrograph. Projectiles were identified by time-of-flight and energy loss in the S800 ion chamber and γ -rays were detected by a 32-fold segmented high-purity germanium detector array (SeGA). Measured $E\gamma$, $I\gamma$, $\gamma\gamma$. Deduced levels, J , π . Comparisons with shell-model calculations.

2007Ba47: $E(^{44}\text{S})=39$ MeV/nucleon secondary beam produced from primary beam of ^{48}Ca produced at GANIL facility with $E=60$ MeV/nucleon. Fragments separated using ALPHA spectrometer. Decay residue identified using time-of-flight and energy loss measurements. Measured $E\gamma$, $I\gamma$ using an array of 74 BaF_2 crystals arranged in two hemispheres above and below the ^9Be target.

2006Fr13 (also 2005Fr19): $E(^{44}\text{S})=98.6$ MeV/nucleon secondary beam produced from fragmentation of ^{48}Ca beam at 140 MeV/nucleon with a ^9Be target. Fragments were separated by A1900 separator at NSCL, Michigan State University (MSU) facility. The ^{44}S beam impinged another ^9Be target and the residues were analyzed by S800 spectrograph. The knockout residues were identified by time-of-flight, energy loss measurement, position and angle information. The γ -rays were detected in coin with knockout residues of ^{43}P using SeGA array of highly-segmented HPGe detectors. Shell-model calculations.

All data from 2008Ri04 unless otherwise noted.

 ^{43}P Levels

$E(\text{level})^\dagger$	$J\pi^\S$	$L^\ddagger$	$\sigma \text{ (mb)}^a$
0.0	$1/2^+$ #	0	2.3 4
184 1	$3/2^+$ @	2	3.1 3
845 3	$(5/2^+)$ &		0.37 7
1009 5	$(5/2^+)$ &	2	0.8 2
1095 6	$(5/2^+)$ &	2	1.9 2
1774 8	$(5/2^+)$		0.4 1
2035 11	$(5/2^+)$ &		0.7 2

† From least-squares fit to $E\gamma$ data (by evaluators).

‡ From parallel momentum distributions and comparison with eikonal-model calculations.

§ From comparisons of experimental data with shell-model calculations.

Configuration= $2s_{1/2}$.

@ Configuration= $1d_{3/2}$.

& Configuration= $1d_{5/2}$.

^a Partial cross section.

 $\gamma(^{43}\text{P})$

$E\gamma$	$E(\text{level})$	$I\gamma$
184 1	184	100
661 4	845	8 1
765 6	1774	3.9 6
825 5	1009	17 1
845 4	845	2.7 7
911 6	1095	25 1
1018 † 6	2035	5 1
1851 11	2035	7 1

† Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas

$Q(\beta^-)=12130$ 100; $S(n)=2629$ 6; $S(p)=20490$ 210; $Q(\alpha)=-16940$ 90 2012Wa38.

$S(2n)=9330$ 6, $S(2p)=38890$ 370, $Q(\beta^-n)=4650$ 140 (2012Wa38).

First identification of ^{43}S nuclide by 1979We10.

^{43}S isotope produced and identified in $^9\text{Be}(^{48}\text{Ca},X)$ $E=212$ MeV/nucleon (1979We10); $^{181}\text{Ta}(^{48}\text{Ca},X)$ (1989Le16) and

$\text{Th}(p,X)$ $E=800$ MeV (1991Zh24), followed by measurement of fragment spectra. Measured (1989Le16) β^-n , $T_{1/2}$.

2012Ch16: TDPAD method used to measure spectroscopic quadrupole moment of $7/2^-$ isomeric state of ^{43}S at 320.5 keV.

$E=345$ MeV/nucleon beam produced at RIKEN-RBF facility using BigRIPS spectrometer for fragment separation. ^{43}mS fragments were selected and implanted in Cu host. The g factor was first measured to validate the method. The 320.5-keV γ -ray was measured using four HPGe detectors. Time spectrum of each detector was used to generate $R(t)$ function.

Mass measurement: 2012Ga45, 2009Ri12, 2007Ju03, 2000Sa21, 1991Zh24.

Mean-square radius from energy-integrated cross sections: 2006Kh08.

Structure calculations: 2011Ka03, 2010Ga15, 2009Ha02.

 ^{43}S Levels**Cross Reference (XREF) Flags**

A ^{43}S IT Decay (415 ns)

B $^9\text{Be}(^{44}\text{S},X\gamma)$

C $^9\text{Be}(^{45}\text{Cl},X\gamma)$

D Coulomb Excitation

E(level) [†]	J π	XREF	$T_{1/2}$	Comments
0.0 [§]	(3/2 ⁻)	ABCD	265 ms 15	$\beta^-n=100$; $\beta^-n=40$ 10 (1989Le16). Configuration= $vp_{3/2}$. This state is found to be part of well deformed $K=1/2$ decoupled rotational band from shell-model calculations. J π : 3/2 ⁻ proposed from shell-model (2000Sa21,2009Ri11,2009Ga05); 7/2 ⁻ proposed (1999Ib01) from syst. $T_{1/2}$: weighted average of 282 ms 27 (2004Gr20) and 260 ms 15 (1998WiZV), from $\beta(^{43}\text{S})$ time correlation measurements. Other: 220 ms +80-50 (1989Le16). Measured mean-square radius (r^2_0)=1.22 fm ² 6 (2006Kh08).
320.7 5	(7/2 ⁻)	A	415 ns 5	$\mu=-1.110$ 14 (2009Ga05,2014StZZ). $Q=0.23$ 3 (2012Ch16,2014StZZ). $T_{1/2}$: from 2009Ga05. Other: 0.48 μs 5 (2000Sa21). J π : 7/2 ⁻ proposed from shell-model calculations (2000Sa21); also from agreement of $g(\text{Schmidt})=-0.546$ for $vf_{7/2}$ with the experimental value (2009Ga05). μ : from g factor= -0.317 4 (2009Ga05) by TDPAD method, the uncertainty includes the statistical and that in the magnetic field. Q: TDPAD method (2012Ch16). This value is significantly larger than predicted by single-particle state which suggests that the isomer is not a spherical state (2012Ch16), only the magnitude is known, not the sign.
970 [§] 5	(5/2 ⁻ , 7/2 ⁻) [‡]	BCD		
1153 [§] 5	(5/2 ⁻ , 7/2 ⁻) [‡]	BC		
2616 9	(7/2 ⁻) [‡]	B		

[†] From least-squares fit to E_γ data.

[‡] Proposed from shell-model calculations (2009Ri11).

[§] (A): Ground-state band.

 $\gamma(^{43}\text{S})$

E(level)	E_γ [†]	I_γ [†]	Mult.	Comments
320.7	320.7 [‡] 5		[E2]	$B(E2)(W.u.)=0.040$ 4. $B(E2)\downarrow=0.357\times 10^{-4}$ 36 (2001Sa72). $B(E2)=0.517\times 10^{-4}$ 52 in 2000Sa21 (same group as 2001Sa72) seems a misprint. E_γ : from ^{43}S IT decay. This γ either feeds the g.s. or a very close-lying level of energy <50 keV. Mult.: for mult=M1 or E1, deduced hindrance factors are unrealistically large. Mult=E2 would be compatible with the measured lifetime.
970	971 6	100		
1153	183 1	53 3		
	1154 7	100		

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued) $\gamma(^{43}\text{S})$ (continued)

E(level)	$E\gamma^\dagger$	$I\gamma^\dagger$
2616	1468 9	5 3
	2600 16	100 7

† From $^9\text{Be}(^{44}\text{S},\text{X}\gamma)$ unless otherwise noted.

‡ Placement of transition in the level scheme is uncertain.

 ^{43}S IT Decay (415 ns) 2000Sa21,2009Ga05

Parent ^{43}S : $E=320.7$ 5; $J\pi=(7/2-)$; $T_{1/2}=415$ ns 5; %IT decay=100.

$^{43}\text{S}-J, T_{1/2}$: From Adopted Levels.

2000Sa21, 2001Sa72: ^{43}S was produced by fragmentation of ^{48}Ca beam at 60 MeV/nucleon on a tantalum target. Measured magnetic rigidity of particles to deduce mass, TOF measurements, $\Delta E-E$ measurement with an array of four-element silicon detector telescope. Delayed γ -rays measured with 4π NaI array surrounding the detector telescope. Precision mass measurement is reported in addition to a new isomer in ^{43}S . Delayed coincidence was measured using two Ge detectors and a Si telescope.

2009Ga05: $E=60$ MeV/nucleon ^{48}Ca beam was produced at GANIL. Fragments were separated by the LISE-2000 spectrometer. A 50 μm thick plastic scintillator at the focal plane was used for g factor measurement using the Time Dependent Perturbed Angular Distribution (TDPAD); four coaxial Ge detectors for γ detection. Measured $E\gamma$, g factor. Comparison with various calculations such as shell-model, particle+rotor model, generator coordinate method (GCM), and Gaussian overlap approximation (GOA).

2012Ka36: ^{43}S was produced by $\text{Be}(^{238}\text{U},\text{F}\gamma)$ with $E=345$ MeV/nucleon ^{238}U beam from the RIBF accelerator at RIKEN on a Be target. Fission fragments were separated and analyzed by BigRIPS separator, transported to focal plane of ZeroDegree spectrometer and finally implanted in an aluminum stopper. Particle identification was achieved by ΔE -tof-B ρ method. Delayed γ -rays from microsecond isomers were detected by three clover-type HPGe detectors (FWHM=2.1 keV at 1 MeV). Measured $E\gamma$, $I\gamma$, $\gamma\gamma$ -coin, isomer half-life. Deduced level. Comparison with previous studies.

 ^{43}S Levels

E(level)	$J\pi$	$T_{1/2}$	Comments
0.0	(3/2-)		$J\pi$: 3/2- proposed from shell-model calculations (2000Sa21,2009Ga05). Configuration= $\nu p_{3/2}$. This state is found to be part of well deformed $K=1/2$ decoupled rotational band from shell-model calculations (2009Ga05).
320.7 5	(7/2-)	0.48 μs 5	$\mu=1.095$ 14 (2009Ga05). $J\pi$: from agreement of $g(\text{Schmidt})=-0.546$ for $\nu f_{7/2}$ with the experimental value (2009Ga05). $T_{1/2}$: from 2009Ga05, from time interval between an event in plastic scintillator and a signal in one of the Ge detectors. Others: 0.45 μs 5 (2000Sa21), 0.20 μs +14-7 (2012Ka36). μ : from g factor=-0.317 4 (2009Ga05) by TDPAD method, the uncertainty includes the statistical and that in the magnetic field. 2009Ga05 state that their g factor indicated that 320.5, $J=7/2-$ level is built on $\nu f_{7/2}$ orbital.

 $\gamma(^{43}\text{S})$

$E\gamma$	E(level)	Mult.	Comments
320.7 5	320.7	[E2]	$B(E2)\downarrow=0.357\times 10^{-4}$ 36 (2001Sa72). $B(E2)=0.517\times 10^{-4}$ 52 in 2000Sa21 (same group as 2001Sa72) seems a misprint. $E\gamma$: weighted average of 320.5 5 (2009Ga05) and 320.9 5 (2012Ka36). Mult.: E1 and M1 give very large hindrance factors. E2 would be compatible with the measured lifetime.

^{43}S IT Decay (415 ns) 2000Sa21,2009Ga05 (continued)Decay Scheme

%IT=100

$^9\text{Be}(^{44}\text{S},\text{X}\gamma)$ 2009Ri11

2009Ri11: E=92 MeV/nucleon ^{44}S beam was produced by fragmentation of a 140 MeV/nucleon ^{48}Ca on a ^9Be fragmentation target and incident on a target of 376 mg/cm² thick ^9Be . Fragments (84% ^{44}S , 14% ^{45}Cl) were separated by the A1900 separator and identified by the time-of-flight and energy loss in the S800 ionization chamber; γ -rays were detected by the Segmented Germanium Array (SeGA). Measured $E\gamma$, $I\gamma$, $\gamma\gamma$ -coin. Deduced levels, J, π , branching ratios and rotational band. Comparisons with shell-model calculations.

This dataset shares the γ -energies with the dataset of $^9\text{Be}(^{45}\text{Cl},\text{X}\gamma)$.

 ^{43}S Levels

$E(\text{level})^\dagger$	$J\pi^\ddagger$
0.0 §	3/2-
970 § 5	(5/2-, 7/2-)
1153 § 5	(5/2-, 7/2-)
2616 9	(7/2-)

[†] From least-squares fit to $E\gamma$ data.

[‡] From comparisons with shell-model calculations.

§ (A): Ground state rotational band.

 $\gamma(^{43}\text{S})$

$E\gamma$	$E(\text{level})$	$I\gamma$	$E\gamma$	$E(\text{level})$	$I\gamma$	$E\gamma$	$E(\text{level})$	$I\gamma$
183 1	1153	53 3	^x 770 5		12 3	1468 9	2616	5 3
^x 231 1		6 1	^x 849 5		24 3	^x 1529 9		8 3
^x 459 3		7 2	971 6	970	56 4	^x 1855 11		5 3
^x 621 4		31 3	1154 7	1153	100	2600 16	2616	98 7
^x 719 4		21 3	^x 1203 7		21 3			

^x γ ray not placed in level scheme.

$^9\text{Be}(^{45}\text{Cl}, \text{X}\gamma)$ 2009Ri11

2009Ri11: E=98 MeV/nucleon ^{45}Cl beam was produced by fragmentation of a 140 MeV/nucleon ^{48}Ca on a ^9Be fragmentation target and incident on a target of 376 mg/cm² thick ^9Be . Fragments (84% ^{44}S , 14% ^{45}Cl) were separated by the A1900 separator and identified by the time-of-flight and energy loss in the S800 ionization chamber; γ -rays were detected by the Segmented Germanium Array (SeGA). Measured $E\gamma$, $I\gamma$, $\gamma\gamma$ -coin. Deduced levels, J, π , branching ratios and rotational band. Comparisons with shell-model calculations.

This dataset shares the γ -energies with the dataset of $^9\text{Be}(^{44}\text{S}, \text{X}\gamma)$.

 ^{43}S Levels

$E(\text{level})^\dagger$	$J\pi^\ddagger$
0.0 §	3/2-
971 § 5	(5/2-, 7/2-)
1154 § 5	(5/2-, 7/2-)

[†] From least-squares fit to $E\gamma$ data.

[‡] From comparisons with shell-model calculations.

§ (A): ground state rotational band.

 $\gamma(^{43}\text{S})$

$E\gamma$	$E(\text{level})$	$I\gamma$	$E\gamma$	$E(\text{level})$	$I\gamma$	$E\gamma$	$E(\text{level})$	$I\gamma$
183 1	1154	58 12	^x 770 5		15 10	1154 7	1154	100
^x 231 1		8 5	^x 849 5		23 12	^x 1203 7		51 15
^x 459 3		10 7	971 6	971	62 17	^x 1529 9		93 22
^x 621 4		34 11	^x 1060 5		40 15			

^x γ ray not placed in level scheme.

Coulomb Excitation 1999Ib01

$^{197}\text{Au}(^{43}\text{S}, ^{43}\text{S}')$ E=42.0 MeV/nucleon. γ -rays detected with an array of 38 cylindrical NaI(Tl) detectors in coin with scattered ^{43}S ions. Comparisons with particle-rotor and particle-vibrator calculations.

 ^{43}S Levels

$E(\text{level})$	Comments
0.0	
≈940	B(E2) $\uparrow$ =0.0175 69. E(level): probably a multiplet. B(E2) applies to the sum of unresolved levels. Experimental B(E2) is consistent with calculated B(E2) for a multiplet of states generated near 1 MeV in either the particle-rotation (prolate and oblate) or the particle-vibration calculations, assuming $J\pi(\text{g.s.})=7/2-$.

 $\gamma(^{43}\text{S})$

$E\gamma$	$E(\text{level})$	Comments
≈940	≈940	$E\gamma$: probably a multiplet.

Adopted Levels, Gammas

$Q(\beta^-)=7690$ 100; $S(n)=7480$ 170; $S(p)=13970$ 100; $Q(\alpha)=-13.92\times 10^3$ 13 2012Wa38.

$S(2n)=13160$ 120, $S(2p)=33920$ 120, $Q(\beta^-n)=2030$ 100 (2012Wa38).

First identification of ^{43}Cl nuclide by 1976Ka24.

^{43}Cl production and identification:

1976Ka24: $^{48}\text{Ca}(^3\text{He},^8\text{B})$ $E=74$ MeV.

1981Vo04: $\text{U}, \text{Nb}(p, X)$ $E=600$ MeV.

1991Zh24, 1990Tu01: $\text{Th}(p, X)$ $E=800$ MeV followed by measurement of fragment spectra.

1998WiZX: fragmentation of ^{48}Ca beam $E(^{48}\text{Ca})=70$ MeV/nucleon with a Be target. Measured γ , $\gamma\gamma$ coin, $\beta\gamma\gamma$ coin.

2006Wi10: ^{43}Cl isotope produced by fragmentation of a ^{48}Ca beam at 70 MeV/nucleon hitting a ^9Be target. The fragments were separated by A1200 fragment separator at NSCL, MSU facility. Measured $E\gamma$, $I\gamma$, $\gamma\gamma$, β , $\beta\gamma$ coin, half-life using two Ge detectors for γ -rays and a plastic scintillator for β particles.

Mass measurements: 1976Ka24, 1990Tu01, 1991Zh24, 2000Sa21, 2007Ju03.

Mean-square radius from energy-integrated cross sections: 2006Kh08.

Structure calculations: 2011Ka03, 2009No01, 1987Sa19.

Level scheme is essentially that proposed in $^9\text{Be}(^{48}\text{K}, X\gamma)$ (2012St12).

 ^{43}Cl Levels

Cross Reference (XREF) Flags

A ^{43}S β^- Decay (265 ms)

B ^{44}S β^-n Decay (100 ms)

C $^1\text{H}(^{46}\text{Ar}, X\gamma)$

D $^9\text{Be}(^{48}\text{K}, X\gamma)$

E $^9\text{Be}(^{48}\text{Ca}, X\gamma)$

F $^{208}\text{Pb}(^{40}\text{Ar}, X\gamma)$

E(level)	$J\pi^\dagger$	XREF	$T_{1/2}$	Comments
0.0	(1/2+)	ABCDEF	3.13 s 9	$\% \beta^- = 100$. Measured mean-square radius (r^2_0)=1.184 fm ² 21 (2006Kh08). $T_{1/2}$: from fit to decay curve (2006Wi10). Earlier result from this group: 3.07 s 7 (1998WiZX). Others: 3.3 s 2 (1981Vo04), 3.4 s 3 (1981HuZT). $J\pi$: 3/2+ proposed (2012Au07) from syst.
328 2	(3/2+)	CDEF		
884? 4	(1/2, 3/2)	CDE		E(level): tentative level proposed in $(^{48}\text{K}, X\gamma)$ from 882 14 γ not in coin with any other γ -ray (2012St12). $E\gamma=888$ 6 in $^1\text{H}(^{46}\text{Ar}, X\gamma)$ (2006Ga31) and 881 5 placed from an 1830 level. $J\pi$: possible γ to (1/2+) is dipole.
943 5	(5/2+)	CDE		
1668 6	(7/2+)	CDE		E(level): level proposed in $(^{48}\text{K}, X\gamma)$ from 1338 15 γ in coin with 327 γ (2012St12). $E\gamma=1342$ 7 in $^1\text{H}(^{46}\text{Ar}, X\gamma)$ (2006Ga31) and 1338 6 placed from a 1338 level.
1924 7		D		

† From transition multipolarities determined from $\gamma(0)$ data in $^9\text{Be}(^{48}\text{Ca}, X\gamma)$ and shell-model predictions (2004So30, 2012St12).

 $\gamma(^{43}\text{Cl})$

E(level)	$E\gamma^\dagger$	$I\gamma$	Mult. ‡
328	328 2	100	D
884?	884 § 4	100	D
943	615 5	100	D
1668	1340 6	100	(Q)
1924	256 4	100	

† Weighted average of all available values.

‡ From $\gamma(0)$ in $^9\text{Be}(^{48}\text{Ca}, X\gamma)$; mult=D indicates $\Delta J=1$ transition and mult=(Q) a $\Delta J=2$ transition.

§ Placement of transition in the level scheme is uncertain.

^{43}S β^- Decay (265 ms) 1989Le16,1991Zh24

Parent ^{43}S : $E=0$; $J\pi=(3/2^-)$; $T_{1/2}=265$ ms 15; $Q(\text{g.s.})=12130$ 100; $\%\beta^-$ decay=100.

$^{43}\text{S}-J, T_{1/2}$: From Adopted Levels.

$^{43}\text{S}-Q(\beta^-)$: From 2012Wa38.

$\%\beta^-n=40$ 10 (1989Le16).

No information is available for population of levels in ^{43}Cl from ^{43}S decay.

 ^{43}Cl Levels

E(level)

0.0

 ^{44}S β^-n Decay (100 ms) 1989Le16,1995So03,2004Gr20

Parent ^{44}S : $E=0$; $J\pi=0^+$; $T_{1/2}=100$ ms 1; $Q(\text{g.s.})=7050$ 100; $\%\beta^-n$ decay=18 3.

$^{44}\text{S}-T_{1/2}$: From ^{44}S Adopted Levels in ENSDF database.

$^{44}\text{S}-Q(\beta^-n)$: From 2012Wa38.

$^{44}\text{S}-\%\beta^-n$ decay: $\%\beta^-n=18$ 3 (1995So03). Other: 30 10 (1989Le16).

No information is available for population of levels in ^{43}Cl from ^{44}S β^-n decay.

 ^{43}Cl Levels

E(level)

0.0

 $^1\text{H}(^{46}\text{Ar}, x\gamma)$ 2006Ga31

2006Ga31: $E=76.4$ MeV/nucleon ^{46}Ar was produced at the Coupled Cyclotron facility of the NSCL at MSU via projectile fragmentation of a 110 MeV/nucleon ^{48}Ca primary beam on a 376 mg/cm 2 ^9Be target located at the mid target position of the A1900 fragment separator. Target of a 191 mg/cm 2 polypropylene $[(\text{C}_3\text{H}_6)_n]$ foil. The fragments were separated by A1900 fragment separator Bp- ΔE -Bp method and identified using the S800 spectrograph. Prompt γ -rays were detected by SeGA γ -detector array of 32-fold segmented HPGe detectors.

The level scheme is taken from $^9\text{Be}(^{48}\text{Ca}, X\gamma)$ in 2004So30.

 ^{43}Cl Levels

<u>E(level)†</u>	<u>$J\pi^\dagger$</u>	<u>Comments</u>
0.0	(1/2+)	
329 4	(3/2+)	
945 7	(5/2+)	
1342 7	(5/2+)	E(level): level not included in Adopted Levels due to revised placement of 1342 γ .
1833 $\frac{7}{2}$ 9	(7/2+)	E(level): level not included in Adopted Levels.

† From level scheme proposed by 2004So30.

$\frac{7}{2}$ A tentative 1509 10 γ from this level reported by 2004So30 is not seen by 2006Ga31.

 $\gamma(^{43}\text{Cl})$

<u>E_γ</u>	<u>E(level)</u>	<u>Comments</u>
$\times 256^\dagger$ 5		
329 4	329	
616 5	945	
888 6	1833	Note that this γ was not observed in coin with 330 γ or 614 γ in 2012St12, thus its placement from 1833 level is suspect.
1342 7	1342	

† This γ not reported by 2004So30.

$\times$ γ ray not placed in level scheme.

$^9\text{Be}(^{48}\text{K}, \text{X}\gamma)$ 2012St12

2012St12: E=85 MeV/nucleon ^{48}K beam was produced from fragmentation of 140 MeV/nucleon ^{48}Ca beam with ^9Be target at the Coupled cyclotron facility of NSCL at MSU. Target=376 mg/cm² ^9Be . The beam was purified in A1900 fragment separator. The S800 spectrograph together with plastic scintillators was used for event-by-event identification of projectile-like reaction products and time-of-flight and energy loss information. Measured $\text{E}\gamma$, $\text{I}\gamma$, $\gamma\gamma$ coin, (fragment) γ coin using SeGA array of 32-fold segmented HPGe detectors. Shell-model calculations.

 ^{43}Cl Levels

$\text{E}(\text{level})^\dagger$	$\text{J}\pi^\ddagger$	Comments
0.0	(1/2+)	
327 5	(3/2+)	
882? 14		
940 9	(5/2+)	
1665 16		E(level): ordering of the 256–1338 γ cascade is not established in this work, but in 2006Ga31, intensity of the 256 γ is much weaker than that of the 1338 γ .
1921 16		

[†] From $\text{E}\gamma$ data.

[‡] From shell-model calculations (2012St12).

 $\gamma(^{43}\text{Cl})$

$\text{E}\gamma$	$\text{E}(\text{level})$	$\text{I}\gamma$	Comments
256 [†] 4	1921	18 1	
327 5	327	100 3	
613 7	940	45 3	
882 14	882?	30 3	882 γ was not observed in coin with either the 327 γ or the 613 γ as proposed in 2004So30.
^x 1024 10		7 2	
1338 [†] 15	1665	22 3	
^x 1494 [‡] 16			
^x 1529 [‡] 16			

[†] Ordering of the 256–1328 γ cascade is not established in this work, but it is based on much weaker intensity of 256 γ in 2006Ga31.

[‡] Weak unresolved doublet.

^x γ ray not placed in level scheme.

 $^9\text{Be}(^{48}\text{Ca}, \text{X}\gamma)$ 2004So30

2004So30: E=60.3 MeV/nucleon ^{48}Ca beam was produced at GANIL and incident on a ^9Be target of 2.76 mg/cm². The SPEG magnetic spectrometer was operated in a dispersive mode to identify the emerging fragments detected at the focal plane. Their energy losses and positions in the focal plane were determined by the combination of ionization and drift chambers. Their residual energies were obtained in a thick plastic scintillator. The time-of-flight was derived from the timing signals in the plastic scintillator with respect to the cyclotron radio frequency. It was corrected by the use of the position of the fragments in the focal plane of the SPEG spectrometer to obtain a better time resolution and subsequently a better identification of the nuclei. Measured $\text{E}\gamma$, $\text{I}\gamma$, $\gamma\gamma$, $\gamma(\theta)$ with an array of 74 BaF₂ and 3 segmented Ge clover detectors to identify the γ -rays emitted in flight by the excited fragments. The segmented Ge detectors at 85°, 122°, and 136° to the beam allowed for angular distribution measurements.

 ^{43}Cl Levels

$\text{E}(\text{level})$	$\text{J}\pi$	Comments
0.0	(1/2+)	
330 5	(3/2+)	
946 7	(5/2+)	
1338 6	(5/2+)	E(level): level not included in Adopted Levels due to revised placement of 1338 γ .
1830 8	(7/2+)	E(level): level not included in Adopted Levels due to revised placement of 882 γ .

$^9\text{Be}(^{48}\text{Ca},\text{X}\gamma)$ 2004So30 (continued) $\gamma(^{43}\text{Cl})$

<u>$E\gamma$</u>	<u>E(level)</u>	<u>$I\gamma$</u>	<u>Mult.</u>	<u>Comments</u>
330 5	330	100	D	Mult.: $\Delta J=1$ transition from $I\gamma(122^\circ)/I\gamma(136^\circ)=1.4$ 4; $I\gamma(85^\circ)/I\gamma(136^\circ)=2.0$ 4.
614 5	946	60	D	Mult.: $\Delta J=1$ transition from $I\gamma(122^\circ)/I\gamma(136^\circ)=1.3$ 4; $I\gamma(85^\circ)/I\gamma(136^\circ)=1.7$ 4.
881 [†] 5	1830	50	D	Note that this γ was not observed in coin with 330 γ or 614 γ in 2012St12, thus its placement from 1830 level is suspect.
1338 6	1338	30	(Q)	Mult.: $\Delta J=1$ transition from $I\gamma(122^\circ)/I\gamma(136^\circ)=1.3$ 3; $I\gamma(85^\circ)/I\gamma(136^\circ)=2.0$ 5. Placement as ground-state transition is incorrect in view of 1338 γ observed in coin with 327 γ in 2012St12.
1509 [†] 10	1830	20		Mult.: $\Delta J=2$ or 0 transition from $I\gamma(122^\circ)/I\gamma(136^\circ)=1.0$ 4; $I\gamma(85^\circ)/I\gamma(136^\circ)=1.0$ 3. E γ : this γ -ray is specified at a 2.5σ confidence level (2004So30).

[†] Placement of transition in the level scheme is uncertain.

 $^{208}\text{Pb}(^{40}\text{Ar},\text{X}\gamma)$ 2013Sz02

Transfer channel: one-proton removal and four-neutron addition 2013Sz02: $E(^{40}\text{Ar})=255$ MeV provided by the ECR ion source and accelerated by the superconducting ALPI-Linac accelerator of LNL, Legnaro facility. Target= $300\text{ }\mu\text{g}/\text{cm}^2$ ^{208}Pb . Measured fragments, $E\gamma$, $I\gamma$, time-of-flight, energy loss, $\gamma\gamma$, (fragment) γ -coin using the Clara array and magnetic spectrometer Prisma. Deduced level, J, π .

 ^{43}Cl Levels

<u>E(level)</u>	<u>$J\pi^\dagger$</u>
0.0	(1/2+)
328 2	(3/2+)

[†] From Adopted Levels.

 $\gamma(^{43}\text{Cl})$

<u>$E\gamma$</u>	<u>E(level)</u>	<u>$I\gamma^\dagger$</u>
328 2	328	30 10

[†] Effective number of counts with correction for detector efficiency.

Adopted Levels, Gammas

Q(β⁻)=4566 5; S(n)=5658 8; S(p)=14390 140; Q(α)=-11270 50 2012Wa38.
S(2n)=15085 5, S(2p)=27579 7 (2012Wa38).
First identification of ⁴³Ar nuclide by 1969Ha03.
1971Ar32: ²³²Th(⁴⁰Ar, X), E=290 MeV; measured fragments isotopic yields.
2005Bl33: measured charge radii.
2007Na31: ¹³⁶Xe(p,X) production cross sections.
Mean-square radius from energy-integrated cross sections: 1999Ai02, 1997Li15.
Mass measurements: 2001He29.
2008Bl01: mass-separated ⁴³Ar ion beam obtained from spallation of Ti by 1.4 GeV beam provided by CERN synchrotron followed by on-line mass separation at ISOLDE-CERN facility. Measured spins, isotope shifts, hyperfine structure, mean-square charge radii, magnetic dipole and electric quadrupole moments by fast beam collinear laser spectroscopy using highly sensitive ion detection of optical resonance. Comparisons with spherical Skyrme-type Hartree-Fock mean-field calculations.
Structure calculations: 2011Ka03, 2007Sh10, 1991Wa19, 1987Sa19, 1974Gl04.

⁴³Ar Levels

Cross Reference (XREF) Flags

A ⁴³Cl β⁻ Decay (3.13 s)
B ¹H(⁴³Ar,p')
C ⁹Be(³⁶S,2pγ)
D ⁴⁸Ca(α,⁹Be)
E ²⁰⁸Pb(⁴⁰Ar,Xγ)

E(level)	Jπ	XREF	T _{1/2}	Comments
0.0	5/2(-)	ABCDE	5.37 min 6	<p>β⁻=100. μ=-1.021 6 (2008Bl01,2014StZZ). Q=+0.142 14 (2008Bl01,2014StZZ). Evaluated rms charge radius=3.4414 fm 41 (2013An02). μ,Q: fast beam collinear laser spectroscopy using highly sensitive ion detection of optical resonance. Statistical uncertainty=0.002 and systematic uncertainty of 10% in Q due to electric field gradient and Sternheimer shielding correction are combined in quadrature. Isotope shift (³⁸Ar,⁴³Ar)=556.7 MHz 23 (2008Bl01); statistical uncertainty=1.4, systematic uncertainty=1.8. Measured mean-square radius (r₀²)=1.23 fm² 8 (beam energy=50 MeV/nucleon, 1999Ai02), 1.31 fm² 7 (beam energy=90 MeV/nucleon, 1999Ai02), 1.23 fm² 3 (beam energy=70 MeV/nucleon, 1997Li15). The rms charge radius (<r²>^{1/2})=3.4415 fm 23 from δ<r²>(³⁸Ar,⁴³Ar)=+0.221 fm² 14(stat) 66(syst) (2008Bl01, laser spectroscopy). Jπ: from laser spectroscopy in 2008Bl01. Hyperfine structure intervals and relative amplitudes of the resonances firmly establish 5/2. log ft=6.6 (log f^{1u}t<8.5) to 3/2- and log ft=6.2 to 5/2+ give 3/2 or 5/2. log ft=7.8 to 7/2- and log ft=7.9 to 7/2+ make 3/2 less likely. Model arguments as discussed by 1999Ma89 propose 5/2- or 7/2- from systematics of N=23 and 25 nuclides. Possible configuration= πd_{3/2}⁻²vf_{7/2}⁻³ (1999Ma89). T_{1/2}: from 1970Hu11 (β and γ activity measurements). Other: 5.35 min 15 (β decay, 1969Ha03), 6.5 min 18 (1969La16). E(level): predicted value of x=100 keV (2011Sz02), 200 keV (2009Mo09). E(level): this level was proposed only in 2009Mo09 but not confirmed in other measurements. It is probably the same level as the 0+x level. Jπ: from theoretical predictions in ⁹Be(³⁶S,2pγ). Jπ: from theoretical predictions in ²⁰⁸Pb(⁴⁰Ar,Xγ).</p>
0+x	(7/2-)	E		
201.27? 16	(7/2-)	C		
762.05 8	(3/2-)	A	E	
1381.74 7		A		
1441.48 10		A		
1527.4+x 5	(11/2-)	E		<p>Jπ: assignment based on conclusion from 1999Ma89 that this is a negative parity state which is dominated by a configuration with the valence neutrons in the fp shell and new results from 2006Wi10. β₂=0.25 3 (1999Ma89). β₂ is from assumed E2 excitation. Jπ: from syst (1999Ma89).</p>
1610 40	(3/2-)	B		<p>E(level): this level may correspond to the 1794 level reported in ⁴³Cl β⁻. Jπ: from shell-model prediction; allowed β⁻ decay from (1/2+).</p>
1740 50		D		
1793.80 10	(3/2+)	A		
1816.8 7		A		

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued) **^{43}Ar Levels (continued)**

E(level)	J π	XREF	Comments
1859+x 2	(9/2-)	E	J π : assignment based on strong $2^+\otimes f_{7/2}$ component of the wave function for the state, similar to that in ^{41}Ar .
1944.96? 21		A	
2344.4 8		A	
2390.50 15		A	
2520.38 13		A D	XREF: D(2550).
2798.8? 5		A	
3374.8? 5		A	
3395.8? 3		A	
3425.5? 5		A	
3549.4? 7		A D	XREF: D(3560).
4247.06 17	(3/2+)	A	J π : log $ft=4.9$ from (1/2+) parent; 4247.0 γ to 5/2(-).
4289.0? 5		A	
4550.8? 4		A	
4740 100		D	

 $\gamma(^{43}\text{Ar})$

E(level)	E γ	I γ	E(level)	E γ	I γ	E(level)	E γ	I γ
201.27?	201.27 16		1859+x	1859 2	100	3395.8?	3395.8 † 3	100
762.05	761.81 11	100	1944.96?	1944.96 † 21	100	3425.5?	1631.8 † 5	100
1381.74	619.56 10	36 3	2344.4	903 †		3549.4?	2108.0 † 7	100
	1381.79 7	100 6		2344 †		4247.06	2430.0 † 5	42 5
1441.48	679.24 10	100 7	2390.50	948.96 17	33 3		2452.7 6	39 5
	1441.69 23	16 3		1008.82 24	13.3 25		2805.43 17	83 9
1527.4+x	1527.4 5	100		1628.1 † 6	13.5 27		2865.7 4	24 4
1793.80	352.13 14	2.3 3		2390.5 4	100 8		4247.0 7	100 20
	411.8 3	1.37 21	2520.38	726.58 8	100 5	4289.0?	2344.0 † 4	100
	1031.84 9	100.0 27		1758.2 5	6.3 26	4550.8?	3109.3 † 4	100
	1793.5 6	3.03 19	2798.8?	2036.4 † 4	100			
1816.8	1816.5 † 3	100	3374.8?	1933.3 † 5	100			

† Placement of transition in the level scheme is uncertain.

 ^{43}Cl β^- Decay (3.13 s) 2006Wi10,1998WiZX,1981HuZT

Parent ^{43}Cl : E=0; J π =(1/2+); T $_{1/2}$ =3.13 s 9; Q(g.s.)=7690 100; % β^- decay=100.

^{43}Cl -J,T $_{1/2}$: From Adopted Levels.

^{43}Cl -Q(β^-): From 2012Wa38.

2006Wi10: ^{43}Cl isotope produced by fragmentation of a ^{48}Ca beam at 70 MeV/nucleon hitting a ^9Be target. The fragments were separated by A1200 fragment separator at NSCL, MSU facility. Measured E γ , I γ , $\gamma\gamma$, β , $\beta\gamma$ coin using two Ge detectors for γ -rays and a plastic scintillator for β -rays. Comparisons with shell-model calculations. 1998WiZX (also 1998WiZV): fragmentation of ^{48}Ca beam E(^{48}Ca)=70 MeV/nucleon with a Be target. Measured γ , $\gamma\gamma$ coin, $\beta\gamma\gamma$ coin.

^{43}Cl identification and production: 1991Zh24 (also 1990Tu01), 1981Vo04, 1976Ka24.

Evaluators consider the decay scheme to be incomplete in view of several uncertain placements of γ transitions and unaccounted 28% 10 β feeding.

 ^{43}Ar Levels

E(level) †	J π	E(level) †	J π	E(level) †	J π
0.0	5/2(-) ‡	1944.96? 21		3395.8? 3	
762.02 8		2344.4 8		3425.5? 5	
1381.73 7		2390.47 15		3549.4? 7	
1441.43 11		2520.35 13		4009.2? 3	
1793.77 11	(3/2+) §	2798.4? 5		4247.02 18	(3/2+) $^\#$
1816.65? 23		3374.8? 5		4289.0? 5	

Continued on next page (footnotes at end of table)

^{43}Cl β^- Decay (3.13 s) 2006Wi10,1998WiZX,1981HuZT (continued) **^{43}Ar Levels (continued)**E(level)[†]

4550.8? 4

[†] From least-squares fit to E γ data.[‡] From Adopted Levels. 1998WiZX suggested 5/2- or 7/2-.[§] From shell-model prediction.[#] Allowed β^- -decay from (1/2+) parent. **β^- radiations**

There is a total of 28% 10 unidentified β feeding (2006Wi10). Up to 8% can be associated with feeding to the ground state. It is possible that some of the unidentified feeding is associated with β -delayed neutron decay of ^{43}Cl .

E β^-	E(level)	I β^- [†]	Log <i>ft</i>	E β^-	E(level)	I β^- [†]	Log <i>ft</i>
(3140 [‡] 100)	4550.8?	0.53 12	5.7 1	(5170 100)	2520.35	3.0 5	6.0 1
(3400 [‡] 100)	4289.0?	1.6 5	5.4 2	(5300 100)	2390.47	4.6 7	5.8 1
(3440 100)	4247.02	5.8 9	4.9 1	(5350 100)	2344.4	3	6.0
(3680 [‡] 100)	4009.2?	0.66 22	5.9 2	(5870 100)	1816.65?	0.98 23	6.7 1
(4140 [‡] 100)	3549.4?	0.33 9	6.5 1	(5900 100)	1793.77	50 7	5.0 1
(4260 [‡] 100)	3425.5?	0.74 17	6.2 1	(6250 100)	1441.43	1.7 6	6.6 2
(4290 [‡] 100)	3395.8?	1.28 22	6.0 1	(6310 100)	1381.73	3.3 6	6.3 1
(4320 [‡] 100)	3374.8?	0.19 12	6.8 3	(7690 [‡] 100)	0.0	<8	>8.5 ^{1u}
(4890 100)	2798.4?	0.33 8	6.8 1				

[†] Absolute intensity per 100 decays.[‡] Existence of this branch is questionable. **$\gamma(^{43}\text{Ar})$**

I γ normalization: Deduced by 2006Wi10 from intensity of γ -rays from ^{43}Ar decay.

E $\gamma^{\dagger}$	E(level)	I $\gamma^{\dagger}$ #	E $\gamma^{\dagger}$	E(level)	I $\gamma^{\dagger}$ #	E $\gamma^{\dagger}$	E(level)	I $\gamma^{\dagger}$ #
352.13 14	1793.77	2.1 3	1441.69 [@] 23	1441.43	1.6 3	2344.4 [‡] @	2344.4	
411.8 3	1793.77	1.23 19	1628.1 [@] 6	2390.47	0.69 14	2344.0 [@] 4	4289.0?	2.7 7
619.56 10	1381.73	2.25 22	1631.8 [@] 5	3425.5?	1.29 23	2390.5 4	2390.47	5.1 4
679.24 10	1441.43	10.0 7	1758.2 5	2520.35	0.31 13	2430.0 [@] 5	4247.02	1.46 19
726.58 8	2520.35	4.94 24	1793.5 [§] 6	1793.77	2.72 17	2452.7 6	4247.02	1.38 17
761.81 11	762.02	100.0 21	1816.5 [@] 3	1816.65?	3.18 24	2805.43 17	4247.02	2.9 3
903.4 [@]	2344.4		1933.3 [@] 5	3374.8?	0.34 20	2865.7 4	4247.02	0.83 14
948.96 17	2390.47	1.69 17	1944.96 [@] 21	1944.96?	3.9 3	3109.3 [@] 4	4550.8?	0.93 15
1008.82 24	2390.47	0.68 13	2036.4 [@] 4	2798.4?	0.57 11	3395.8 [@] 3	3395.8?	2.24 20
1031.84 9	1793.77	89.7 24	2108.0 [@] 7	3549.4?	0.58 13	4247.0 7	4247.02	3.5 7
1381.79 7	1381.73	6.3 4	2215.4 [@] 3	4009.2?	1.2 3			

[†] From 2006Wi10, unless otherwise stated.[‡] From 1981HuZT only.[§] From 1998WiZX only.[#] For absolute intensity per 100 decays, multiply by 0.57 8.[@] Placement of transition in the level scheme is uncertain.

^{43}Cl β^- Decay (3.13 s) 2006Wi10,1998WiZX,1981HuZT (continued)

Decay Scheme

$^1\text{H}(^{43}\text{Ar}, \text{p}') 1999\text{Ma89}$

1999Ma89: ^{43}Ar secondary beam produced by the fragmentation of a ^{48}Ca beam at $E=60$ MeV/nucleon, provided by the K1200 cyclotron at the NSCL, on a 285 mg/cm^2 Be production target, followed by a fragment-separator analyzer. Intensity of ^{43}Ar beam=16,000 particles/sec at 33 MeV/nucleon. Target of a thin 2 mg/cm^2 CH_{2n} foil. Recoiling protons were detected by a group of eight particle-detector telescopes (FWHM=850 keV). Measured $\sigma(E_p, \theta)$. Deduced levels, J, π from DWBA analysis.

 ^{43}Ar Levels

E(level)	J π	L	Comments
0.0	(5/2-, 7/2-)		J π : from systematics (1999Ma89). 7/2- is inconsistent with log ft values.
1610 40	(3/2-)	2	L: from $\sigma(\theta)$ and comparison with DWBA calculations. J π : suggested by syst (1999Ma89). $\beta_2=0.25$ 3, assuming E2 excitation. For analysis of (p,p') data, J π (g.s.)=5/2- was assumed by 1999Ma89.

 $^9\text{Be}(^{36}\text{S}, 2\text{p}\gamma) 2009\text{Mo09}$

2009Mo09: $E=95$ MeV ^{36}S beam was produced from the Tandem Accelerator at Maier-Leibnitz-Laboratorium. Targets of $610 \text{ }\mu\text{g/cm}^2$ Be evaporated on 36 mg/cm^2 Au backing. Charged particles were detected by eleven telescopes and γ -rays by five Compton-suppressed Ge detectors. Measured E_γ , I_γ , (particle)- γ coincidence. Deduced levels.

 ^{43}Ar Levels

E(level)	J π	Comments
0.0	5/2(-)	J π : from Adopted Levels.

Continued on next page

$^9\text{Be}(^{36}\text{S}, 2p\gamma)$ 2009Mo09 (continued) ^{43}Ar Levels (continued)

<u>E(level)</u>	<u>Jπ</u>	<u>Comments</u>
201.27? 16	(7/2-)	E(level): this level is uncertain since it has not been observed and confirmed in other experiments. J π : from theoretical predictions.

 $\gamma(^{43}\text{Ar})$

<u>Eγ</u>	<u>E(level)</u>
201.27 16	201.27?

 $^{48}\text{Ca}(\alpha, ^9\text{Be})$ 1974Je01

1974Je01: E=77.7 MeV α beam with intensity of $\approx 1 \mu\text{A}$ was produced from the Lawrence Berkeley Laboratory 88-in cyclotron. Target of a 96.25% isotopically enriched self-supporting ^{48}Ca . Recoiling particles were detected by two counter telescopes, each consisting of two transmission (ΔE -E) detector, 59 and 35 μm thick, a 260 μm E detector, and a 500 μm reject detector. Measured $\sigma(\text{E})$. Deduced levels.

 ^{43}Ar Levels

<u>E(level)</u>
0.0
1740 50
2550 50
3560 70
4740 100

 $^{208}\text{Pb}(^{40}\text{Ar}, \text{X}\gamma)$ 2011Sz02

2011Sz02: E=255 MeV ^{40}Ar beam from an ECR ion source accelerated by the superconducting ALPI accelerator of the Laboratory Nazionali di Legnaro. Target=300 $\mu\text{g}/\text{cm}^2$ ^{208}Pb . Projectile-like fragments identified by spectrometer Prisma by ΔE , E and time-of-flight measurements. γ -rays detected by the Clara array, consisting of twenty-four HPGe clover-type detectors. Measured E γ , I γ , fragment- γ coincidence. Deduced levels, J, π . Comparison with shell-model calculations. Also 2013Sz01.

 ^{43}Ar Levels

<u>E(level)</u>	<u>J$\pi^\dagger$</u>	<u>Comments</u>
0.0	(5/2-)	
0+x	(7/2-)	E(level): x = 100 keV predicted. Previous assignment of a 200-keV γ -ray from this level (2009Mo09) was not confirmed in the present work.
762.3 4	(3/2-)	
1527.4+x 5	(11/2-)	J π : assignment based on conclusion from 1999Ma89 that this is a negative parity state which is dominated by a configuration with the valence neutrons in the fp shell and new results from 2006Wi10.
1859+x 2	(9/2-)	J π : assignment based on strong $2^+(^{42}\text{Ar})@v f_{7/2}$ component of the wave function for the state, similar to that in ^{41}Ar .

† From theoretical predications by shell-model calculations (2011Sz02).

 $\gamma(^{43}\text{Ar})$

<u>Eγ</u>	<u>E(level)</u>	<u>Iγ</u>
762.3 4	762.3	64 21
1527.4 5	1527.4+x	100 16

Continued on next page (footnotes at end of table)

208Pb(⁴⁰Ar,Xγ) 2011Sz02 (continued)
γ(⁴³Ar) (continued)

<u>Eγ</u>	<u>E(level)</u>	<u>Iγ</u>
1859 2	1859+x	37 15

Adopted Levels, Gammas

$Q(\beta^-)=1833.4\ 5$; $S(n)=9624.7\ 4$; $S(p)=9442\ 6$; $Q(\alpha)=-9200.1\ 18$ 2012Wa38.

$S(2n)=17158.5\ 4$, $S(2p)=23850\ 40$ (2012Wa38).

Hyperfine studies, isotope shifts, moments, radius: 2014Pa45, 2014Kr04, 1982To02, 1982Du06.

Mass Measurements: 2007Ya08.

^{43}K Levels

Cross Reference (XREF) Flags

A $^{43}\text{Ar}\ \beta^-$ Decay (5.37 min)	E $^{44}\text{Ca}(\mu^-, \nu n\gamma)$
B $^9\text{Be}(^{36}\text{S}, n p\gamma)$	F $^{44}\text{Ca}(d, ^3\text{He})$
C $^{40}\text{Ar}(\alpha, p\gamma), ^{41}\text{K}(t, p\gamma)$	G $^{44}\text{Ca}(t, \alpha)$
D $^{41}\text{K}(t, p)$	H $^{44}\text{Ca}(^{11}\text{B}, ^{12}\text{C})$

E(level) [†]	J π [§]	XREF	T _{1/2} [‡]	Comments
0.0	3/2+	ABCDEFGH	22.3 h 1	% β^- =100. $\mu=+0.1633\ 8$ (1982To02,2014StZZ). μ : ABLDS method (1982To02,1982Du06). Other: 1959Pe26. Evaluated rms charge radius=3.4556 fm 86 (2013An02). Adopted (by 1977En02) spectroscopic factor S=4.0 15 (proton pickup). $\delta\langle r^2 \rangle(^{47}\text{K}, ^{43}\text{K})=+0.049\ \text{fm}^2\ 19(\text{stat})\ 69(\text{syst})$ (2014Kr04) for $\delta\nu(^{39}\text{K}, ^{43}\text{K})=+459.0\ \text{MHz}\ 12$ from literature. T _{1/2} : weighted average of 21.75 h 50 (1963Ho17), 22.1 h 1 (1972Em01), and 22.6 h 2 (1972Wa20). Other: 1955Ne01, 1969Ta07. J π : spin from atomic-beam method; also from fitting of hyperfine structure (2014Pa45,2014Kr04); parity from L(t,p)=0; L(d, ^3He)=L(t, α)=2. Configuration= $\pi 1d_{3/2}^{-1}$ (92%) (2014Pa45) from shell-model calculations.
561.20@ 5	1/2+	ABCDEFGH	1.4 ps +17-7	Adopted (by 1977En02) spectroscopic factor S=1.9 5 (proton pickup). J π : L(d, ^3He)=0. XREF: F(748).
738.30& 6	7/2-	ABC EFGH	200 ns 5	$\mu=+4.43\ 5$ (1983Ra37,2014StZZ). μ : TDPAD method (1983Ra37). Others: 1976We23, 1976De41. J π : L(d, ^3He)=L(t, α)=3; 5/2 ruled out by $\Delta J=2$ to 3/2+ from $\gamma(0,\text{pol})$ in ($\alpha, p\gamma$). T _{1/2} : from $p\gamma(t)$ in ($\alpha, p\gamma$). XREF: D(1007)H(984).
975.32 6	3/2-	ABCDEFGH	1.6 ps +14-6	J π : L(d, ^3He)=1; L(t,p)=3. XREF: F(1119)H(1121).
1109.93 6	3/2+	ABCDEFGH	1.0 ps 8	J π : L(d, ^3He)=L(t, α)=L(t,p)=2; 5/2 not allowed by RUL for γ to 1/2+.
1206.91 6	(5/2, 7/2)+	ABCD G	>4.8 ps	J π : L(t,p)=2 from 3/2+; γ from 7/2+ probably not E2 from RUL; L(t, α)=(2) supports 5/2+.
1509.99@ 6	7/2+	ABCD	5.7 ps 15	J π : L(t,p)=2 from 3/2+ and $\Delta J=2$, E2 to 3/2+ from $\gamma(0,\text{pol})$ in ($\alpha, p\gamma$). J π : L(d, ^3He)=2. J π : L(t,p)=4 from 3/2+.
1549.96 9	3/2+, 5/2+ [#]	A C FG	0.09 ps 6	J π : stretched E2 to 7/2- from $\gamma(0,\text{pol})$ in ($\alpha, p\gamma$). J π : γ to 1/2+, log ft=7.7 from 5/2(-) parent.
1815 10	(5/2 to 11/2)+	D		J π : L(t,p)=4 from 3/2+.
1849.57& 8	11/2-	BC G	4.6 ps 12	J π : γ to 1/2+, log ft=7.7 from 5/2(-) parent.
1865.65 8	(3/2, 5/2+)	A C F		J π : L(t,p)=4 from 3/2+.
1956 10	(5/2 to 11/2)+	D		XREF: C(?).
1986.57 8	(9/2)	BC		J π : $\Delta J=1$ stretched dipole to 7/2+.
2035 10	3/2+	D		J π : L(t,p)=0 from 3/2+.
2048.88 9	(9/2)	ABC	1.7 ps 6	J π : γ to 7/2- and RUL; $\Delta J=1$ stretched dipole to 7/2+.
2081.0 4	(5/2, 7/2)+	B D		J π : L(t,p)=4 from 3/2+; γ to 3/2+.
2177.68 11	5/2(+)	A C fg	<0.07 ps	J π : γ decays to 3/2-, 3/2+, 7/2- and 7/2+; L(t, α)=(2). But the parity is inconsistent with log ft=5.8 from 5/2(-) parent.
2189.32 14	(3/2, 5/2, 7/2)	A fg		J π : γ to 3/2+; log ft=7.4 from 5/2(-) parent. L(t, α)=(2) for a 2180 group gives (3/2+, 5/2+) for one of the levels near this energy.
2218 10	(3/2 to 9/2)-	D		J π : L(t,p)=3 from 3/2+.

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Adopted Levels, Gammas (continued) ^{43}K Levels (continued)

E(level) [†]	J π [§]	XREF	T _{1/2} [‡]	Comments
2344.96 9	(3/2-)	A C	0.7 ps +14-4	J π : γ decays to 1/2+ and (5/2,7/2)+; log ft=5.6 from 5/2(-) parent.
2451 10	1/2+	FG		T=5/2.
2508.34 [@] 10	(11/2+)	BCD	>5 ps	J π : L($^3\text{He},d$)=L(t,α)=0. J π : L(t,p)=(4) from 3/2+; $\Delta J=2$, Q γ to 7/2+; possible positive-parity yrast band member.
2548 10	(1/2, 3/2, 5/2)-	D		J π : L(t,p)=1 from 3/2+.
2668 15	3/2+, 5/2+ [#]	FG		
2784 10	(1/2 to 7/2)+	D		J π : L(t,p)=2 from 3/2+.
2879 10	(1/2 to 7/2)+	D		J π : L(t,p)=2 from 3/2+.
2981 15		G		
2986.76 19	(13/2-)	B		J π : probably high spin formed in coupling an f _{7/2} proton with four f _{7/2} neutrons in a 4 ⁺ configuration.
3057.26 21	(5/2)+	A fG		J π : L($d,^3\text{He}$)=2; γ to 7/2-.
3084 15	3/2+, 5/2+	fG		J π : L($d,^3\text{He}$)=2.
3114.69 ^{&} 10	15/2-	BC	3.5 ps 7	J π : stretched E2 to 11/2- from $\gamma(\theta,\text{pol})$ in ($\alpha,p\gamma$).
3139.39 10	(13/2)	BC		J π : $\Delta J=1$ stretched dipole to (11/2).
3150 18		G		
3190 10	(1/2 to 7/2)+	D		J π : L(t,p)=2 from 3/2+.
3229 15	3/2+, 5/2+ [#]	FG		
3264.34 11	(3/2, 5/2)+	A D		XREF: D(3254). J π : γ to 1/2+; L(t,p)=2 from 3/2+; log ft=5.9 from 5/2(-) parent.
3309.86 13	(3/2, 5/2)+	A D		J π : γ decays to 3/2-, 3/2+ and (5/2,7/2)+; L(t,p)=2 from 3/2+; log ft=5.1 from 5/2(-) parent is inconsistent with positive parity.
3342 15	3/2+, 5/2+ [#]	FG		
3393.14 20	(3/2 to 7/2)+	A D		J π : L(t,p)=2 from 3/2+; log ft=6.2 from 5/2(-) parent.
3455.60 12	(3/2-)	A G		J π : γ to 1/2+; log ft=5.1 from 5/2(-) parent.
3580 30		G		
3591.28 [@] 10	(15/2+)	B		J π : $\Delta J=2$ stretched quadrupole to (11/2+) from DCO ratios possible positive-parity yrast band member in.
3608.46 15	(5/2-, 7/2-)	A		J π : log ft=5.1 from 5/2(-) parent; γ transitions to 7/2- and 7/2+.
3646.1 4	(3/2, 5/2, 7/2+)	A G		J π : γ transitions to 3/2+ and (5/2,7/2)+; log ft=5.9 from 5/2(-).
3714.16 22	(3/2+, 5/2+)	A FG		XREF: F(3730). J π : γ transitions to 3/2+, 3/2- and (5/2,7/2)+; L($d,^3\text{He}$)=(2); log ft=5.6 from 5/2(-) is inconsistent with positive parity.
3837 15		G		
3880 15	(3/2+, 5/2+)	FG		J π : L($d,^3\text{He}$)=(2).
3970? 30		G		
3985.28 25		B		
4018 15	3/2+, 5/2+ [#]	FG		
4070 30		G		
4124 15	3/2+, 5/2+ [#]	FG		J π : L($d,^3\text{He}$)=2; but L(t,α)=(0) is inconsistent.
4177 15		G		
4234 15		G		
4290 30		G		
4410 40		G		
4472 15	3/2+, 5/2+ [#]	FG		
4540 40		G		
4540.4 3		B		
4680? 40		G		
4794 15	3/2+, 5/2+ [#]	FG		
4860? 40		G		
4920? 40		G		
4930.3 3	(19/2-)	B		J π : comparison with negative-parity levels of ^{45}Sc suggests that the 1816 keV transition corresponds to the decay of a 19/2- level to the 15/2- level at 3116 keV (1998Mo16).
5030 40		G		
5150? 40		G		
5194 30	3/2+, 5/2+ [#]	FG		

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Adopted Levels, Gammas (continued)

⁴³K Levels (continued)

E(level) [†]	Jπ [§]	XREF	Comments
5260 40		G	
5380 40		G	
5610 30	3/2+, 5/2+#	F	
5900 30	3/2+, 5/2+#	F	
7450 30	(3/2+, 5/2+)	F	Jπ: L(d, ³ He)=(2).

[†] From least-squares fit to E_γ data for levels populated in γ-ray studies. For others, weighted averages of available values are taken.

[‡] From DSAM in (α,pγ),(t,pγ), unless otherwise stated.

[§] When L-transfer arguments are used, the target is Jπ=0+, except for ⁴¹K(t,p), where target Jπ=3/2+. Arguments based on log ft values are considered as tentative since the decay scheme of ⁴³Ar decay is not considered as well established.

L(d,³He) and/or L(t,α)=2.

@ (A): Possible positive-parity yrast band. Band from 1992Ko15.

& (B): Possible negative-parity yrast band. Band from 1992Ko15.

γ(⁴³K)

E(level)	E _γ [†]	I _γ [‡]	Mult. [§]	δ [§]	Comments
561.20	561.10 5	100			
738.30	738.23 6	100	M2+E3	-0.13 2	B(M2)(W.u.)=0.0567 15; B(E3)(W.u.)=7.7 24.
975.32	414.0 1	4.3 3	[E1]		B(E1)(W.u.)=0.00020 +8-18.
	975.3 1	100.0 3	[E1]		B(E1)(W.u.)=0.00036 +14-32.
1109.93	548.62 6	43 5			
	1110.1 1	100 5			
1206.91	1206.95 9	100			
1509.99	303.09 5	9 2			
	1510.05 7	100 2	E2		B(E2)(W.u.)=1.3 4.
1549.96	439.3 3	12 2			
	1550.0 1	100 2			
1849.57	1111.14 6	100	E2		B(E2)(W.u.)=8.1 22.
1865.65	755.0 3	1.5 5			
	890.4 1	100 3			
	1304.3 7	2.6 5			
	1866.1 2	59 3			
1986.57	476.58 6	100	D		
2048.88	1310.58 7	100	D		
2081.0	873.9 4	100 24			
	2081.3 7	66 22			
2177.68	667.5 3	0.53 13			
	1202.4 3	30 5			
	1439.8 2	100 5			
	2176.2 7	0.79 13			
2189.32	639.7 3	13.5 14			
	1080.0 3	22 4			
	2189.2 3	100 4			
2344.96	167.1 2	1.13 13			
	479.2 2	53 3			
	1138.1 2	3.8 8			
	1235.7 3	2.8 5			
	1369.9 2	90 5			
	1783.7 2	5.6 5			
	2344.5 2	100 5			
2508.34	460.5 6	100 3	D+Q	-0.2	
	998.81 13	69 4	Q		
2986.76	478.39 16	100			
3057.26	2318.9 2	100			
3114.69	1265.09 7	100	E2		B(E2)(W.u.)=5.6 12.
3139.39	630.86 12	13.4 18	D(+Q)		
	1289.62 8	100 12	D		
3264.34	1398.7 1	63 4			
	2287.6 5	33 6			

E_γ: poor fit; Δ(E_γ) was increased from 0.2 to 0.5 by evaluators.

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Adopted Levels, Gammas (continued) $\gamma(^{43}\text{K})$ (continued)

E(level)	$E\gamma^{\dagger}$	$I\gamma^{\ddagger}$	Mult. [§]	$\delta^{\S}$	Comments
3264.34	3264.3 2	100 6			
3309.86	1121.0 3	4.0 18			
	1132.6 2	15 3			
	1443	60 12			
	2102.3 5	12 3			
	2333.9 2	100 12			
	3309.9 3	9.2 12			
3393.14	3393.0 2	100			
3455.60	1277.9 5	3.8 6			
	1590.4 2	16.2 16			
	1905.9 6	6.0 11			
	2345	1.9 6			
	2479.9 2	100 3			
	2894.2 2	27 2			
	3455.1 4	3.0 17			
3591.28	451.82 4	72.6 19	D+Q	-0.2	
	476.4 3	11 5	D		
	1083.15 7	100 11	Q		
3608.46	1419.3 2	100 9			
	1559.9# 2	147 22			
	2057.9 3	83 9			
	2097.8 5	76 15			
	2401.8 3	22 5			
	2870.1 3	58 7			
3646.1	2438.9 5	100 5			
	2535.7 7	18 5			
	3646.4 5	7.3 16			
3714.16	1369	4.3 25			
	2506.7 15	10 3			
	2603.4 4	10 4			
	2739.5 7	22 4			
	3714.3 3	100 6			
3985.28	1477.0 3	100 20			
	1936.4 5	64 17			
4540.4	555.2 3	100 22			
	1401.0 5	86 22			
	1553.1 6	93 22			
4930.3	1815.61 26	100 15			

[†] From β^- decay, ($\alpha, p\gamma$), ($t, p\gamma$) and ($^{36}\text{S}, n\gamma$).[‡] Primarily from β^- decay. Weighted averages are taken when values with uncertainties are also available from $^9\text{Be}(^{36}\text{S}, n\gamma)$, ($\alpha, p\gamma$), ($t, p\gamma$).[§] From ($\alpha, p\gamma$), ($t, p\gamma$) and ($^{36}\text{S}, n\gamma$).

Placement of transition in the level scheme is uncertain.

 ^{43}Ar β^- Decay (5.37 min) 1978Hu10Parent ^{43}Ar : $E=0$; $J\pi=5/2(-)$; $T_{1/2}=5.37$ min 6; $Q(\text{g.s.})=4566$ 5; % β^- decay=100. $^{43}\text{Ar}-J, T_{1/2}$: From Adopted Levels of ^{43}Ar . $^{43}\text{Ar}-Q(\beta^-)$: From 2012Wa38.1978Hu10: ^{43}Ar isotopes were produced in the spallation reaction $^{50}\text{V}(p, 6\text{pxn})$ with the proton beam from the 600 MeV external beam of the CERN synchrocyclotron bombarding a vanadium carbide target. Argon nuclides were separated in the ISOLDE on-line mass separator. γ -rays were detected in Ge(Li) detectors. Measured $E\gamma$, $I\gamma$, $\gamma\gamma$. Deduced levels, branching ratios. See also 1970Hu11.

Others:

1969La16: $E\gamma$, $T_{1/2}$.1969Ha03: $T_{1/2}$.

All data from 1978Hu10 unless otherwise noted.

The decay scheme is considered incomplete in view of no uncertainties available on γ -ray intensities. Thus all β feedings and $\log ft$ values are considered as approximate. In Adopted dataset, $\log ft$ have been used but the $J\pi$ based on these are considered as tentative.

⁴³Ar β⁻ Decay (5.37 min) 1978Hu10 (continued)

⁴³K Levels

No evidence was found by 1978Hu10 for a 2892.7 level proposed by 1970Hu11.

E(level) [†]	Jπ [‡]	E(level) [†]	Jπ [‡]	E(level) [†]	Jπ [‡]
0.0	3/2+	1549.90 9	3/2+, 5/2+	3264.18 10	(3/2, 5/2)+
561.32 7	1/2+	1865.73 7	(3/2, 5/2+)	3310.11 9	(3/2, 5/2)+ [#]
738.03 8	7/2-	2048.5? § 1	(9/2)	3393.14 20	(3/2, 5/2, 7/2)+
975.31 6	3/2-	2177.72 8	5/2(+)	3455.49 9	(3/2-)
1109.96 7	3/2+	2189.32 11	(3/2, 5/2, 7/2)	3608.50 12	(5/2-, 7/2-)
1206.94 10	(5/2, 7/2)+	2345.02 7	(3/2-)	3646.1 4	(3/2, 5/2, 7/2+)
1509.85 9	7/2+	3057.00 22	(5/2)+	3714.29 17	(3/2+, 5/2+)

[†] From least-squares fit to Eγ data. Since the quoted Δ(Eγ) result in a poor fit, these were increased to 0.2 keV for strong γ-rays and 0.3 keV for weak γ-rays (Iγ<1%) in the least-squares adjustment.

[‡] From Adopted Levels.

§ Level proposed (evaluators) based on (α,γ) and 1560-1311 coin in 1978Hu10. But the adopted Jπ=(9/2) is inconsistent with the log ft=7.8 from 5/2(-) parent.

log ft=5.1 allowed decay from 5/2(-) parent is inconsistent with parity=+.

β⁻ radiations

Eβ ⁻	E(level)	Iβ ⁻ [‡]	Log ft	Eβ ⁻	E(level)	Iβ ⁻ [‡]	Log ft
(852 5)	3714.29	0.47	5.5	(2388 5)	2177.72	16	5.8
(920 5)	3646.1	0.28	5.8	(2700 5)	1865.73	0.32	7.7
(958 5)	3608.50	1.5	5.2	(3016 5)	1549.90	0.29	7.9
(1111 5)	3455.49	3.5	5.1	(3056 5)	1509.85	0.37	7.9
(1173 5)	3393.14	0.38	6.1	(3359 5)	1206.94	1.5	7.4
(1256 5)	3310.11	5.5	5.1	(3456 5)	1109.96	0.9	7.7
(1302 5)	3264.18	1.0	5.9	(3591 5)	975.31	16	6.5
(1509 5)	3057.00	1.1	6.1	(3828 5)	738.03	1.4	7.7
(2221 5)	2345.02	19	5.6	(4005 § 5)	561.32	0.1	9.0
(2377 5)	2189.32	0.39	7.4	(4566 5)	0.0	30 [†]	6.7

[†] Estimated (by 1978Hu10) from a comparison of the observed ⁴³Ar-⁴³K (parent-daughter) activities with those expected from series decay.

[‡] Absolute intensity per 100 decays.

§ Existence of this branch is questionable.

γ(⁴³K)

Iγ normalization: Σ(Iγ to g.s.)=70 7, based on Iβ(g.s.)=30 7 (1978Hu10).

Eγ	E(level)	Iγ ^d	Mult.	δ	Eγ	E(level)	Iγ ^d
167.1 1	2345.02	2.5			1080.0& 2	2189.32	4.6
^x 231.4 1		2.8			1110.1 1	1109.96	31.2
^x 236.2 1		3.4			1121.0 2	3310.11	3.2
302.9 2	1509.85	1.9			1132.6 1	3310.11	12.2
413.9 1	975.31	42.9			1138.1 1	2345.02	8.7
439.3 2	1549.90	2.8			^x 1146.4 2		9.1
479.2 1	2345.02	116.0			^x 1184.3 3		5.1
548.5 1	1109.96	13.4			1202.4 3	2177.72	98.3
561.1 1	561.32	94.0			1207.1 3	1206.94	75.8
^x 587.0 [†] 1		9.0			1235.7 ^a 2	2345.02	6.3
639.7 3	2189.32	2.7			^x 1255.6 3		3.2
667.5 2	2177.72	1.9			1277.9 5	3455.49	2.5
738.1 1	738.03	454.8	M2+E3 §	-0.13 § 2	1304.3 7	1865.73	3.1
755.0 3	1865.73	1.8			1311.4 ^e 1	2048.5?	22.7
^x 812.4 4		1.3			1369	3714.29	0.4
^x 878.2 8		0.9			1369.9 1	2345.02	200.0
890.4 1	1865.73	118.3			1398.7 1	3264.18	9.5
^x 910.5 9		1.0			1419.3 1	3608.50	12.9
^x 922.5 5		1.7			1439.8 1	2177.72	369.0
974.9 [#] 1	975.31	1000			1443	3310.11	48.0

Continued on next page (footnotes at end of table)

^{43}Ar β^- Decay (5.37 min) 1978Hu10 (continued) $\gamma(^{43}\text{K})$ (continued)

E_γ	E(level)	I_γ^d	E_γ	E(level)	I_γ^d	E_γ	E(level)	I_γ^d
$^{x1487.8\ 5}$		2.7	$^{x1950.8\ 3}$		10.0	2603.4 4	3714.29	0.9
1509.7 1	1509.85	20.7	2057.9 3	3608.50	10.7	2701.9 5	3264.18	1.3
1550.0 1	1549.90	22.9	2097.8 5	3608.50	9.8	2739.5 7	3714.29	2.1
1559.9 ^{c e} 1	3608.50	15.9	2102.3 5	3310.11	9.8	2870.1 2	3608.50	7.5
1590.4 2	3455.49	10.6	2176.2 7	2177.72	2.5	2894.2 2	3455.49	17.9
$^{x1605.7\ 8}$		2.6	2189.2 3	2189.32	20.4	$^{x2976.2\ 3}$		2.8
$^{x1621.7\ 5}$		5.5	2287.6 ^b 2	3264.18	4.7	3264.3 2	3264.18	14.7
$^{x1713.3\ 6}$		3.2	2318.9 2	3057.00	31.0	3309.9 2	3310.11	7.4
$^{x1724.6\ 2}$		9.3	2333.9 2	3310.11	81.9	$^{x3380.6\ 7}$		0.8
$^{x1750.0\ 5}$		2.0	2344.5 2	2345.02	217.3	3393.0 2	3393.14	11.2
$^{x1758.2\ddagger\ 2}$		10.2	2345	3455.49	1.2	3455.1 4	3455.49	2.0
1783.7 2	2345.02	12.6	2401.8 3	3608.50	2.8	3646.4 5	3646.1	0.5
$^{x1849.6\ 8}$		2.5	2438.9 5	3646.1	6.4	3714.3 2	3714.29	9.5
1866.1 [@] 1	1865.73	70.4	2479.9 1	3455.49	65.5			
$^{x1889.2\ 7}$		3.0	2506.7 15	3714.29	1.0			
1905.9 6	3455.49	3.9	2535.7 7	3646.1	1.2			

† In coin with 1758 γ .‡ In coin with 587 γ .

§ From Adopted Gammas.

Level-energy difference=975.4 1.

@ Level-energy difference=1865.6 1.

& Level-energy difference=1079.3 2.

a Level-energy difference=1235.0 2.

b Poor fit. Level-energy difference=2288.6 2.

c Placement (evaluator) based on 1560–1310 $\gamma\gamma$ coin.

d For absolute intensity per 100 decays, multiply by 0.034 4.

e Placement of transition in the level scheme is uncertain.

x γ ray not placed in level scheme.

Decay Scheme

Intensities: I_γ per 100 parent decays

⁴³Ar β⁻ Decay (5.37 min) ¹⁹⁷⁸Hu10 (continued)

⁹Be(³⁶S,npγ) 1992Ko15,1998Mo16

1992Ko15: E=100 MeV ³⁶S beam was produced from the Argonne Tandem Linac Accelerator System (ATLAS). Target of a 2.34 mg/cm² thick rolled ⁹Be foil evaporated onto a 10 mg/cm² Pb backing. Charged particles were detected by two Si surface-barrier detector telescopes at forward angles and γ-rays were detected by eight Compton-suppressed Ge detectors (CSGs). Measured E_γ, I_γ, γγ(θ), DCO. Deduced levels, J, π, branching ratios.

1998Mo16: E=90–110 MeV ³⁶S beam was produced from the TANDEM accelerator of the University and Technical University Munich and impinged on beryllium targets. Recoils were identified by the Munich high-frequency recoil spectrometer and detected in ionization chamber. γ-rays were detected by an annular Compton-suppressed HPGe detector positioned at 180° relative to the beam direction, FWHM=2.8 keV at 1.3 MeV. Measured E_γ, I_γ, γγ(θ), pγ-coin, (recoil)γ-coin. Deduced levels, branching ratios. Comparisons with shell-model calculations.

⁴³K Levels

E(level)	Jπ [†]	E(level)	Jπ [†]	E(level)	Jπ [†]
0.0	3/2+	1850.43 ^a 7	11/2- [‡]	3140.04 8	(13/2) [§]
561.13 ^{&} 4	1/2+	1986.66 10	(9/2) [§]	3591.90 ^{&} 8	(15/2+) [§]
738.28 ^a 5	7/2-	2048.89 7	(9/2) [§]	3985.69 24	
975.09 4	3/2-	2081.0 4	(5/2, 7/2)+	4540.9 3	
1109.83 6	3/2+	2508.84 ^{&} 7	(11/2+) [§]	4931.2 3	(19/2-) [@]
1206.97 7	(5/2, 7/2)+	2987.26 17	(13/2-) [#]		
1510.07 ^{&} 7	7/2+	3115.53 ^a 10	15/2- [‡]		

[†] From Adopted Levels unless otherwise noted.

[‡] From ΔJ=2 transitions indicated by R_{DCO} (1992Ko15).

[§] From ΔJ=1 transitions indicated by R_{DCO} (1992Ko15).

[#] Probably high spin formed in coupling an f_{7/2} proton with four f_{7/2} neutrons in a 4⁺ configuration (1992Ko15).

[@] Comparison with negative-parity levels of ⁴⁵Sc suggests that the 1816 keV transition corresponds to the decay of a 19/2- level to the 15/2- level at 3116 keV (1998Mo16).

[&] (A): Possible positive-parity yrast band (1992Ko15).

^a (B): Possible negative-parity yrast band (1992Ko15).

γ(⁴³K)

Unplaced γ-rays from 1998Mo16.

DCO ratios measured as I(90°)/I(147°), statistical uncertainties only (1992Ko15). 1.2–1.4 for stretched dipole and 0.8–0.9 for stretched quadrupole.

E _γ [†]	E(level)	I _γ [‡]	Mult. [@]	δ [@]	Comments
303.10 5	1510.07	4.42 14			
413.97 [§] 5	975.09	0.58 [§] 7			
451.82 4	3591.90	7.7 2	D+Q	-0.2	R _{DCO} =0.89 5 gated on 3140 to 1850 transition; 1.06 12 gated on 3140 to 2509 transition.
459.93 4	2508.84	21.2 6	D+Q	-0.2	R _{DCO} =0.92 3 gated on 2049 to 738 transition.
476.4 [§] 3	3591.90	1.2 [§] 5	D		R _{DCO} =0.77 10 gated on 3116 to 1850 transition.
476.58 6	1986.66	5.2 3	D		R _{DCO} =1.31 9 gated on 1510 g.s. transition.
478.39 16	2987.26	2.36 10			R _{DCO} =1.04 11 gated on 2509 to 1510 transition; 0.90 3 gated on 2509 to 2049 transition.
^x 540.7 4		4.6 13			
^x 543.1 5		4.0 13			
548.65 [§] 5	1109.83	6.8 [§] 3			
555.2 [#] 3	4540.9	1.4 [#] 3			
561.10 5	561.13	7.7 6			
630.86 [§] 12	3140.04	1.5 [§] 2	D(+Q)		R _{DCO} =1.42 22 gated on 2509 to 1510 transition; 1.32 3 gated on 2509 to 2049 transition.
738.26 5	738.28	>18			I _γ : the decaying state is a long-lived state and most γ transitions from this state were outside the coincidence window (1992Ko15). It is greater than 100 from intensity balance.
873.9 [#] 4	2081.0	4.1 [#] 10			
975.06 5	975.09	9.3 3			
998.77 8	2508.84	14.7 8	Q		R _{DCO} =0.72 5 gated on 1510 g.s. transition.
1083.15 7	3591.90	10.6 12	Q		R _{DCO} =0.64 7 gated on 2509 to 1510 transition.
1110.0 1	1109.83	11.2 22			
1112.15 6	1850.43	100 3	Q		R _{DCO} =0.77 3 gated on 738 g.s. transition.
1206.94 9	1206.97	13.9 4			
1265.09 7	3115.53	34.4 11	Q		R _{DCO} =0.93 4 gated on 1850 to 738 transition.
1289.62 8	3140.04	11.2 13	D		R _{DCO} =1.5 1 gated on 1850 to 738 transition.

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⁹Be(³⁶S,npγ) 1992Ko15,1998Mo16 (continued)

γ(⁴³K) (continued)

Eγ [†]	E(level)	Iγ [‡]	Mult. [@]	Comments
1310.56 7	2048.89	25.5 7	D	R _{DCO} =1.22 10 gated on 738 g.s. transition.
1401.0 [#] 5	4540.9	1.2 [#] 3		
1477.0 [#] 3	3985.69	5.9 [#] 12		
1510.18 18	1510.07	38.1 12		
1553.1 [#] 6	4540.9	1.3 [#] 3		
^x 1798.5 4		4.5 12		
^x 1810.0 6		4.5 13		
1815.61 [#] 26	4931.2	18.3 [#] 27		
1936.4 [#] 5	3985.69	3.8 [#] 10		
2081.3 [#] 7	2081.0	2.7 [#] 9		
^x 2124.9 4		7.0 14		
^x 2219.8 6		4.0 10		
^x 2442.3 6		2.9 10		
^x 2521.6 5		4.3 11		

[†] Weighted average from 1992Ko15 and 1998Mo16 unless otherwise noted.

[‡] Weighted or unweighted average from 1992Ko15 and 1998Mo16 unless otherwise noted.

[§] From 1992Ko15 only.

[#] From 1998Mo16 only.

[@] From 1992Ko15.

^x γ ray not placed in level scheme.

⁴⁰Ar(α,pγ),⁴¹K(t,pγ) 1979Be28,1978MeZX

Includes ⁴He(⁴⁰Ar,pγ) from 1983Ra37.

1979Be28: E=7-17 MeV α beam. Target of 2-5 mg/cm² solid natural Ar at 12-17 K on a 250 μm thick Ta backing.

Compton-suppressed Ge(Li) detectors for detecting γ-rays. Measured Eγ, γγ, γ(θ), γ(lin pol). Deduced levels, J, π, T_{1/2} from DSAM.

1978MeZX: E=11.7 MeV α beam. Measured Eγ, Iγ, pγ(t). Deduced levels, T_{1/2} by DSAM.

Others:

1984Ra23 and 1983Ra37: ⁴He(⁴⁰Ar,pγ) E=185, 190 MeV ⁴⁰Ar beam was produced the VICKSI accelerator. Helium gas target.

NaI detector. Measured γ(θ,H,t). Deduced g factor and T_{1/2}, hyperfine interactions.

1980OlZX: E=116-11.9 MeV α beam. Measured γ(θ), γγ, T_{1/2} by DSAM.

1977Po07: E=10.4 MeV α beam. Argon gas target. Protons were detected by a surface-barrier detector and γ-rays were detected by a 5 cm by 5cm NaI(Tl). Measured γ(t). Deduced T_{1/2}.

1976We23: E=15 MeV α beam was produced from the Triangle Universities Nuclear Laboratory (TUNL) FN tandem accelerator facility. Argon gas target. Two 7.6 by 7.6 cm NaI detectors for detecting γ-rays. Measured γγ(θ,H,t). Deduced g factor, T_{1/2}.

1976De41: E=12.7 MeV. Measured pγ(θ,H,t). Deduced g factor, T_{1/2}.

1975Bo30: E=11.7 MeV α beam. Pure natural argon gas target. Two surface barrier detectors for detecting scattered α-particles; a 84 cm³ Ge(Li) detector for detecting γ-rays. Measured γ(θ), p-γ(t), T_{1/2}(level).

1964La14: E=20 MeV α beam was produced from the Copenhagen cyclotron. Pure argon gas target. Protons were detected in a ionization chamber or a proportional counter; γ-rays were detected by a NaI crystal. Measured σ(E_p), pγ.

⁴³K Levels

E(level) [†]	Jπ [§]	T _{1/2}	Comments
0.0	3/2+		
561.7 [#] 4	1/2+	1.4 ps [#] +17-7	
738.2 5	7/2-	200 ns 5	T _{1/2} : from pγ(t). Weighted average of 202 ns 4 (1983Ra37,1984Ra23), 184 ns 10 (1977Po07), 165 ns 17 (1976De41), 205 ns 10 (1975Bo30,1978MeZX).
975.3 [#] 4	3/2-	1.6 ps [#] +14-6	
1110.7 [#] 4	3/2+	1.0 ps [#] 8	
1207.0 4	(5/2, 7/2)+	>4.8 ps [@]	T _{1/2} : >2.1 ps (1978MeZX).
1510.1 4	7/2+	5.7 ps [@] 15	T _{1/2} : 1.7 ps +11-6 (1978MeZX).
1549.8 [#] 5	3/2+, 5/2+	0.09 ps [#] 6	
1850.0 [‡] 6	11/2-	4.6 ps [@] 12	
1866.2 4	(1/2, 3/2, 5/2+)		E(level): from 1978MeZX.
1987? [‡] 1	(9/2)		

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$^{40}\text{Ar}(\alpha, p\gamma), ^{41}\text{K}(t, p\gamma)$ 1979Be28, 1978MeZX (continued) **^{43}K Levels (continued)**

E(level) [†]	J π [§]	T _{1/2}
2048.4 [‡] 5	(9/2)	1.7 ps@ 6
2177.4 [#] 7	5/2(+)	<0.07 ps [#]
2343.8 [#] 7		0.7 ps [#] +14-4
2509.5 [‡] 5	(11/2+)	>5 ps@
3115.2 [‡] 7	15/2-	3.5 ps@ 7
3139 [‡] 1	(13/2)	

[†] From least-squares fit to E γ data, assuming $\Delta(E\gamma)=0.5$ or 1 keV when not given by the authors.

[‡] From 1979Be28.

[§] From Adopted Levels.

[#] From 1978MeZX. Lifetime from DSAM.

@ From DSAM (1979Be28).

 $\gamma(^{43}\text{K})$

A₂, A₄ and polarization coefficients are from 1979Be28.

E(level)	E γ [†]	I γ [‡]	Mult. [§]	δ [§]	Comments
561.7	561.6 [#]				
738.2	738.4 [#]		M2+E3	-0.13 2	A ₂ =+0.17 2, A ₄ =-0.04 2. Pol=-0.23 4.
975.3	413.3 [#]	8 5			
	975.4 [#]	92 5			
1110.7	549.1 [#]	40 10			
	1110.5 [#]	60 10			
1207.0	1206.9 5				
1510.1	303.1 2	7 4			
	1509.9 6	93 4	E2		A ₂ =+0.29 2, A ₄ =-0.07 2. Pol=+0.53 16.
1549.8	1549.8 [#]				
1850.0	1111.8 4		E2		A ₂ =+0.35 2, A ₄ =-0.21 3. Pol=+0.47 6.
1866.2	890.6 [#]				
	1866.4 [#]				
1987?	477@				
2048.4	1310.4 6				
2177.4	1439.1 [#]				
2343.8	477.6 [#]				
2509.5	461.1 2				
	999.3 3				
3115.2	1265.1 4		E2		A ₂ =+0.46 2, A ₄ =-0.19 2. Pol=+0.88 20.
3139	1289				

[†] From 1979Be28, unless otherwise stated.

[‡] From 1978MeZX.

[§] From $\gamma(\theta)$ and $\gamma(\text{lin pol})$ (1979Be28).

[#] From 1978MeZX.

@ Placement of transition in the level scheme is uncertain.

 $^{41}\text{K}(t, p)$ 1984Mo17

Target ^{41}K J $\pi=3/2+$.

1984Mo17: E=15 MeV triton beam was produced from the University of Pennsylvania FN tandem accelerator. Target of 55 $\mu\text{g}/\text{cm}^2$ thick KCl enriched to 99.35% in ^{41}K . Protons were momentum analyzed with a multi-angle spectrograph and recorded in 7.5° intervals in the angular range 3.75°–86.25° (lab), FWHM=20 keV. Measured $\sigma(E_p, \theta)$. Deduced levels, J, π , L from DWBA analysis.

1978MeZX: $^{41}\text{K}(t, p\gamma)$ E=11.7 MeV.

All data from 1984Mo17.

${}^{41}\text{K}(\text{t},\text{p})$ 1984Mo17 (continued) **${}^{43}\text{K}$ Levels**

<u>E(level)[†]</u>	<u>L[‡]</u>	<u>E(level)[†]</u>	<u>L[‡]</u>	<u>E(level)[†]</u>	<u>L[‡]</u>
0.0	0	1956 10	4	2879 10	2
560 10	2	2035 10	0	3190 10	2
1007 10	3	2086 10	4	3254 10	2
1113 10	2	2218 10	3	3312 10	2
1214 10	2	2512 10	(4)	3399 10	2
1517 10	2	2548 10	1		
1815 10	4	2784 10	2		

[†] Uncertainty of 10 keV assigned by 1990En08.

[‡] From comparison of $\sigma(\theta)$ data with DWBA calculations.

 ${}^{44}\text{Ca}(\mu^-, \nu n \gamma)$ 2006Me08

2006Me08: the μ^- beam obtained from decay of π^- beam at 90 MeV/c from the M9B beam line at TRIUMF, including a 6-m, 1.2-T superconducting solenoid, beam rate $2 \times 10^5 \text{ s}^{-1}$. Target of pure natural calcium with some oxide on the surface was contained in plastic containers with polyethylene walls. Three plastic scintillation counters were used to define the muon beam; two HPGe detectors for detecting γ -rays, FWHM=3 keV at 1.2 MeV. Measured $E\gamma$, $I\gamma$, $\gamma\gamma$, γ -p. Deduced levels.

Muonic Lyman series for natural Calcium

μ x-ray	Energy	Intensity in percent
2p-1s	783.659 25	83.8 10
3p-1s	940.63 10	6.2 2
4p-1s	995.48 10	2.0 1
5p-1s	1020.81 10	2.0 1
6p-1s	1034.62 10	1.8 1
7p-1s	1042.71 20	1.4 1
(8- ∞)p-1s	1046-1063	2.8 4

Muonic Balmer series for natural Calcium

μ x-ray	Energy	Intensity in percent
3d-2p	157.35 13	64.5 9
4d-2p	212.03 10	8.85 20
5d-2p	237.31 10	4.34 20
6d-2p	251.06 10	3.29 20
7d-2p	259.45 10	1.37 20
(8- ∞)d-2p	261-277	1.4 3

 ${}^{43}\text{K}$ Levels

<u>E(level)[†]</u>	<u>Jπ[†]</u>
0.0	3/2+
561.2	1/2+
738.3	7/2-
975.3	3/2-
1109.9	3/2+

[†] From Adopted Levels, Gammas.

${}^{44}\text{Ca}(\mu^-, \nu n \gamma)$ 2006Me08 (continued) $\gamma({}^{43}\text{K})$

$E\gamma^\dagger$	E(level)	Percent γ -ray yield ‡
548.6	1109.9	<0.1
561.1	561.2	0.3 <i>I</i>
738.2	738.3	0.45 <i>I2</i>
975.3	975.3	0.2 <i>I</i>
1110.1	1109.9	<0.2

 † From Adopted Levels, Gammas. ‡ Absolute intensity per 100 incident particles. **${}^{44}\text{Ca}(\text{d}, {}^3\text{He})$ 1976Do05**

1976Do05 (also 1975Wa17): E=52 MeV deuteron beam was produced from the Karlsruhe isochronous cyclotron and impinged on an 98.55% enriched self-supporting ${}^{44}\text{Ca}$ foil. ${}^3\text{He}$ particles were detected by counter telescopes consisting of 300 μm ΔE and 2000 μm E surface barrier counters, FWHM=120 keV. Measured $\sigma(E({}^3\text{He}), \theta)$. Deduced levels, J, π , L, spectroscopic factors from DWBA analysis.

1974De36, E=19 MeV deuteron beam was produced from the University of Minnesota MP Tandem and impinged on a 60 $\mu\text{g}/\text{cm}^2$ target prepared by evaporating a 98.5% enriched ${}^{44}\text{Ca}$ onto a 15 $\mu\text{g}/\text{cm}^2$ carbon foil. ${}^3\text{He}$ particles were detected by solid state position detectors placed in the focal plane of an Enge split-pole spectrometer, FWHM=15 keV. Measured $\sigma(E({}^3\text{He}), \theta)$. Deduced, levels, J, π , L, spectroscopic factors from DWBA analysis.

1969Yn01: E=22 MeV deuteron beam was produced from the Argonne cyclotron and impinged on enriched ${}^{44}\text{Ca}$ target on Formvar backing. ${}^3\text{He}$ particles were detected with a ΔE -E telescope of surface-barrier detectors, FWHM=70-130 keV. Measured $\sigma(E({}^3\text{He}), \theta)$. Deduced, levels, J, π , L, spectroscopic factors from DWBA analysis.

Target ${}^{44}\text{Ca}$ $J\pi=0^+$.

All data from 1976Do05 unless otherwise noted.

 ${}^{43}\text{K}$ Levels

E(level)	L	$\text{C}^2\text{S}^\ddagger$	Comments
0.0	2	3.15	C^2S : 2.90 (1974De36), 4.5 (1969Yn01).
566 † 8	0	1.15	C^2S : 1.55 (1974De36), 2 (1969Yn01).
748 † 8	3	0.85	C^2S : 0.98 (1974De36).
982 † 8	1	0.16	C^2S : 0.27 (1974De36).
1119 † 8	2	0.36	C^2S : for d5/2. $\text{C}^2\text{S}=0.50$ for d3/2. Other: 0.30 (1974De36).
1540 15	2	0.24	
1870 15			
2180 15			
2450 15	0	0.32	
2670 15	2	0.41	
3070 15	2	0.16	
3230 15	2	0.20	
3340 15	2	0.56	
3730 15	(2)	0.13	
3880 15	(2)	0.1	
4020 15	2	0.15	
4120 15	2	0.31	
4470 15	2	0.17	
4790 15	2	0.14	
5190 30	2	0.23	
5610 30	2	0.23	
5900 30	2	0.30	
7450 30	(2)	0.1	

 † From weighted average of 1974De36 and 1976Do05. ‡ From 1976Do05. 1978En02 give S-factors which are adjusted upwards by $\approx 19\%$ using standard normalization factors as discussed in 1977En02.

${}^{44}\text{Ca}(t,\alpha)$ 1968Sa09,1970Aj01

Target ${}^{44}\text{Ca}$ $J\pi=0+$.

1968Sa09: E=13 MeV triton beam was produced from the Aldermaston tandem accelerator and impinged on an enriched target of ${}^{44}\text{Ca}$. Alpha particles were momentum analyzed in the multi-angle spectrograph and detected in Ilford K1 emulsions. Measured $\sigma(E_\alpha, \theta)$. Deduced levels, J , π , spectroscopic factors from DWBA analysis.

1970Aj01: E=20 MeV triton beam was produced from the Los Alamos MEG Tandem facility and impinged on a ${}^{44}\text{Ca}$ target of a 205 $\mu\text{g}/\text{cm}^2$ layer of calcium metal deposited on a 50 $\mu\text{g}/\text{cm}^2$ carbon foil, oriented at 30° to the beam. Alpha particles were analyzed in an Elbek-type spectrograph and detected with Ilford K-minus-one nuclear plates. Measured $\sigma(E_\alpha, \theta)$. Deduced levels.

 ${}^{43}\text{K}$ Levels

$E(\text{level})^\dagger$	$L^\ddagger$	$S^\S$	$E(\text{level})^\dagger$	$L^\ddagger$	$S^\S$	$E(\text{level})^\dagger$
0.0	2	2.2	3150 18			4234 15
560 15	(0)	1.3	3228 21	2	0.19	4290@ 30
740 15	3	0.48	3344 19	2	0.45	4410@ 40
967 15	(1)	0.10	3460@ 30			4490?@ 40
1107 15	2	0.20	3580@ 30			4540@ 40
1202 15	(2)	0.06	3670@ 30			4680?@ 40
1544 15			3717 15			4820@ 40
1847 15			3837 15			4860?@ 40
2177 15	(2)	0.05	3890@ 30			4920?@ 40
2446 17	0	0.24	3970?@ 30			5030@ 40
2666 16	2	0.45	4015# 15		0.24	5150?@ 40
2981 15			4070@ 30			5200@ 40
3056 17			4127# 15	(0)	0.06	5260@ 40
3084# 15			4177 15			5380@ 40

† From weighted average of 1968Sa09 and 1970Aj01.

‡ From 1968Sa09.

§ 1978En02 point out that absolute S-factors given by 1968Sa09 are quite large; therefore, 1978En02 prefer to give relative S-factors, normalized to 3.8 for the ground state.

From 1968Sa09 only.

@ Reported by 1970Aj01 only.

 ${}^{44}\text{Ca}({}^{11}\text{B}, {}^{12}\text{C})$ 1978DeZD

1978DeZD (also 1976DeXS): E=50 MeV. Measured $\sigma(\theta)$.

 ${}^{43}\text{K}$ Levels

$E(\text{level})$	$J\pi^\dagger$	$S^\ddagger$
0.0 §	3/2+	2.9
567 §	1/2+	1.2
741#	7/2-	1.5
984#	3/2-	0.30
1121	3/2+	0.30

† From Adopted Levels.

‡ From bar chart shown in Fig. 2 of 1978DeZD.

§ $\sigma(\theta)$ distribution fits well with DWBA calculations.

Poor fit of $\sigma(\theta)$ distribution with DWBA calculations.

Adopted Levels, Gammas

$Q(\beta^-) = -2220.7$ 19; $S(n) = 7932.89$ 17; $S(p) = 10675.76$ 25; $Q(\alpha) = -7592$ 5 2012Wa38.
 $S(2n) = 19413.56$ 18, $S(2p) = 19919.3$ 4 (2012Wa38).
 Hyperfine structure measurements: 2011Av01, 2004Mo21, 2000Mu17.

 ^{43}Ca Levels

Cross Reference (XREF) Flags

A ^{43}K β^- Decay (22.3 h)
 B ^{43}Sc ϵ Decay (3.891 h)
 C $^{27}\text{Al}(^{19}\text{F}, 2p n \gamma)$
 D $^{30}\text{Si}(^{18}\text{O}, \alpha n \gamma)$
 E $^{40}\text{Ar}(\alpha, n \gamma)$
 F $^{41}\text{K}(^3\text{He}, p)$
 G $^{41}\text{K}(\alpha, d)$
 H $^{42}\text{Ca}(n, \gamma)$ E=thermal

I $^{42}\text{Ca}(n, \gamma), (n, n)$: Resonances
 J $^{42}\text{Ca}(d, p)$
 K $^{42}\text{Ca}(\alpha, ^3\text{He})$
 L $^{43}\text{Ca}(p, p')$
 M $^{43}\text{Ca}(p, p' \gamma)$
 N $^{43}\text{Ca}(d, d')$
 O $^{43}\text{Ca}(\alpha, \alpha')$
 P $^{44}\text{Ca}(p, d)$

Q $^{44}\text{Ca}(d, t)$
 R $^{44}\text{Ca}(^3\text{He}, \alpha), (\text{pol } ^3\text{He}, \alpha)$
 S $^{44}\text{Ca}(^3\text{He}, \alpha \gamma)$
 T $^{45}\text{Sc}(\mu^-, 2n \gamma)$
 U $^{45}\text{Sc}(d, \alpha)$
 V Coulomb Excitation

E(level) [†]	J $\pi^{\ddagger}$	XREF	T _{1/2} [#]	Comments
0.0	7/2-	ABCDEFGH JKLMNOPQRSTU	stable	<p>$\mu = -1.31726$ 60 (1972O101, 2014StZZ). $Q = -0.0408$ 8 (1991Si14, 2008Py02, 2014StZZ). Evaluated rms charge radius = 3.4954 fm 19 (2013An02). μ: optical method (1972O101). Other: -1.317643 7 (NMR, 1973Lu08). Q: from CFBL method (revised value by 1993Su36 from -0.043 9 (1991Si14). Other measurements: -0.062 12 (ABMR-LIRF, 1982Ay02), -0.065 20 (ABMR, laser spectroscopy, 1979Gr05), -0.040 8 (optical isotope shift method, 1980Be13, 1981Ar15). Recalculations and analyses: -0.0552 11 (2002Mi37), -0.0408 8 (1993Su36, 2008Py02), -0.049 5 (1984Sa10, 1983Ar25, 1982O105). Measured $\Delta\langle r^2 \rangle(^{43}\text{Ca}-^{40}\text{Ca}) = 0.117$ fm² 25 (1981Wo02), 0.1254 fm² 32 (1984Pa12), 0.1215 fm² 4 (1991Si14). Adopted (by 1977En02) spectroscopic factor $S = 0.58$ 6 (neutron stripping); 3.1 3 (neutron pickup). $J\pi$: $L(d, p) = L(d, t) = L(\alpha, ^3\text{He}) = L(p, d) = L(\text{pol } ^3\text{He}, \alpha) = 3$; J from optical spectroscopy (1954Ke14); $L(\alpha, d) = 5$. Adopted (by 1977En02) spectroscopic factor $S < 0.02$ (neutron stripping); 0.17 8 (neutron pickup). $J\pi$: $L(d, t) = L(\alpha, ^3\text{He}) = L(p, d) = L(d, t) = L(\text{pol } ^3\text{He}, \alpha) = 3$; $\gamma(\theta)$ and $\gamma(\text{lin pol})$ in $(\alpha, n \gamma)$. Adopted (by 1977En02) spectroscopic factor $S = 0.04$ 2 (neutron stripping); 0.10 3 (neutron pickup). $J\pi$: $L(d, p) = L(\alpha, ^3\text{He}) = L(d, t) = L(p, d) = L(\text{pol } ^3\text{He}, \alpha) = 1$; $\Delta J = 2$ to 7/2- from $\gamma(\theta)$ and $\gamma(\text{lin pol})$ in $(\alpha, n \gamma)$. $T_{1/2}$: other: 160 ps 10 from $p' \gamma(t)$ in $(p, p' \gamma)$. Adopted (by 1977En02) spectroscopic factor $S = 0.11$ 2 (neutron stripping); 2.2 4 (neutron pickup). $J\pi$: $L(d, p) = L(d, t) = L(\alpha, ^3\text{He}) = L(p, d) = L(\text{pol } ^3\text{He}, \alpha) = 2$; $L(^3\text{He}, p) = 0$; $\Delta J = 1$ to 5/2- from $\gamma(\theta)$ and $\gamma(\text{lin pol})$ in $(\alpha, n \gamma)$. $T_{1/2}$: weighted average of 48 ps 4 from $(\alpha, n \gamma)$ and 51 ps 8 from $(^{19}\text{F}, 2p n \gamma)$. $J\pi$: $L(d, t) = L(\alpha, ^3\text{He}) = L(p, d) = 2$; $\Delta J = 1$ to 7/2- from $\gamma(\theta)$ and $\gamma(\text{lin pol})$ in $(\alpha, n \gamma)$.</p>
372.762 5	5/2-	ABCDE H JKLMNOPQRSTU	34 ps 3	
593.394 5	3/2-	ABCDE H JKLMNOPQRS UV	81 ps 4	
990.257 ^{&} 5	3/2+	A CDEF H JKLM PQRS U	49 ps 4	
1394.473 ^a 8	5/2+	A CDEF H JKLM PQRS U	1.84 ps [@] 35	

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Adopted Levels, Gammas (continued) ^{43}Ca Levels (continued)

E(level) [†]	$J\pi^{\ddagger}$	XREF		$T_{1/2}^{\#}$	Comments
1677.84 17	11/2-	CDE	JKLMNQP S UV	0.85 ps@ 14	$J\pi$: $L(\alpha, \alpha')=2+4$; $\Delta J=2$ to 7/2- from $\gamma(\theta)$ and $\gamma(\text{lin pol})$ in $(\alpha, n\gamma)$.
1901.99& 14	7/2+	CDE	J LM	0.53 ps@ 10	$J\pi$: $\Delta J=2$ E2 to 3/2+ from $\gamma(\theta)$ and $\gamma(\text{lin pol})$ in $(\alpha, n\gamma)$ and RUL.
1931.53 14	5/2-	B E	J LMNO S	116 fs@ 30	$J\pi$: $L(\alpha, \alpha')=2+4$; $\Delta J=0$ or 1 to 3/2-, 5/2- and 7/2- from $\gamma(\theta)$ and $\gamma(\text{lin pol})$ in $(\alpha, n\gamma)$ and RUL.
1957.4 4	1/2+	E H	JKL PQR	1.1 ps 3	Adopted (by 1977En02) spectroscopic factor $S=0.05$ 2 (neutron stripping); 1.0 2 (neutron pickup).
2046.21 15	3/2-	EF	JKLMNQPQR	0.8 ps 2	$J\pi$: $L(d, p)=L(d, t)=L(p, d)=L(\text{pol } ^3\text{He}, \alpha)=0$. Adopted (by 1977En02) spectroscopic factor $S=0.72$ 9 (neutron stripping); 0.19 6 (neutron pickup).
2067.21 17	7/2-	E	LMNO	21 fs 7	$J\pi$: $L(d, p)=L(\alpha, ^3\text{He})=L(d, t)=L(p, d)=L(\text{pol } ^3\text{He}, \alpha)=1$; $L(\alpha, \alpha')=2+4$ and γ to 7/2- reject 1/2-.
2093.81 18	9/2-	CDE	LMNO	1.4 ps@ 4	$J\pi$: $L(d, d')=4$; $L(\alpha, \alpha')=2+4$; $\Delta J=1$ to 5/2- from $\gamma(\theta)$ and $\gamma(\text{lin pol})$ in $(\alpha, n\gamma)$. $T_{1/2}^{\#}$ from DSAM in $(p, p'\gamma)$.
2102.7 3	3/2-	E H J	L	0.33 ps 9	$J\pi$: $L(\alpha, \alpha')=2+4$; $\Delta J=1$ to 7/2- from $\gamma(\theta)$ and $\gamma(\text{lin pol})$ in $(\alpha, n\gamma)$.
2223.9 4	3/2-, 5/2-	E	J LM	28 fs 17	$J\pi$: $L(d, p)=1$; γ to 7/2-.
2248 8			JK		$J\pi$: $\Delta J=0$ or 1 to 3/2- and 5/2- from $\gamma(\theta)$ and $\gamma(\text{lin pol})$ in $(\alpha, n\gamma)$; positive sign gives unacceptable M2 strength from $(\alpha, n\gamma)$.
2249.01 14	9/2-	E	LMNO	37 fs@ 8	$J\pi$: $L(d, d')=4$; $L(\alpha, \alpha')=2+4$; $\Delta J=2$ to 5/2- from $\gamma(\theta)$ and $\gamma(\text{lin pol})$ in $(\alpha, n\gamma)$.
2272.8 3	3/2+, 5/2+	EF H J	LM PQ	0.28 ps 8	XREF: P(2250).
2409.68 ^a 15	9/2+	CDE	J LM	1.2 ps@ 4	$J\pi$: $L(d, t)=L(p, d)=2$.
2523 10	(1/2-, 3/2-)		J		$J\pi$: γ decays to 5/2+, 7/2+ and 7/2-; $\Delta J=2$ to 5/2+ from $\gamma(\theta)$ and $\gamma(\text{lin pol})$ in $(\alpha, n\gamma)$.
2611.1 3	1/2-	E H	JKL Q	0.13 ps 5	$J\pi$: $L(d, p)=1$.
2674.3 8	5/2-, 7/2-	E	JKLM O	36 fs@ 16	$J\pi$: $L(d, p)=L(\alpha, ^3\text{He})=3$.
2696.5 5	3/2+, 5/2+	E	J LM OPQ S	<38 fs	XREF: P(2660)Q(2680).
2748 8	1/2+		JK1		$J\pi$: $L(d, p)=L(d, t)=L(p, d)=2$; $L(\alpha, \alpha')=2+4$ is presumed to be in error or for a different level at 2694 5.
2754.00 21	15/2-	CDE	l O	23.6 ps 10	$J\pi$: $L(d, p)=0$.
2769.6 5	(1/2, 3/2, 5/2)	E		0.10 ps 4	$J\pi$: $\Delta J=2$ to 11/2- from $\gamma(\theta)$ and $\gamma(\text{lin pol})$ in $(\alpha, n\gamma)$ and from DCO in $(^{18}\text{O}, \alpha n\gamma)$.
2844.7 5	(5/2)+	EF	JKL OPQ	0.55 ps 15	$T_{1/2}^{\#}$ weighted average from $(^{19}\text{F}, 2pn\gamma)$.
2878.7 10	1/2-	E H J	L S	107 fs 38	$J\pi$: γ to 3/2+ and 3/2-.
2943.5 3	3/2-	E H	JK1 S	<60 fs	$J\pi$: $L(p, d)=L(d, t)=2$ and γ to 7/2-. $L(d, p)=0$ suggests 1/2+. $L(\alpha, d)=4+6$ from 3/2+ is inconsistent with $J=5/2$.
2951.33& 19	11/2+	CDE G	l O	4.7 ps 12	$J\pi$: $L(d, p)=1$. $\gamma(\text{circ pol})$ in $(\text{pol } n, \gamma)$ does not allow 3/2-. $\gamma(\theta)$ of 2504 γ in $(^3\text{He}, \alpha\gamma)$ is inconsistent with $J=1/2$. It is possible that the level seen in $(^3\text{He}, \alpha\gamma)$ is different from that in (n, γ) and $(\alpha, n\gamma)$.

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Adopted Levels, Gammas (continued) ^{43}Ca Levels (continued)

E(level) [†]	$J\pi^{\ddagger}$	XREF				$T_{1/2}^{\#}$	Comments
3028.7 8	(3/2 to 7/2)	E	J	l	O S	<60 fs	$J\pi$: γ to 5/2-; $\Delta J=1$ to 5/2- from $\gamma(\theta)$ in ($^3\text{He}, \alpha\gamma$).
3030.4 7	(1/2, 3/2, 5/2)			l	S		E(level): not resolved from 3028.6; γ decay seen only in ($^3\text{He}, \alpha\gamma$).
3049.6 15		E	JKL	P		<60 fs	$J\pi$: γ decays to 3/2+, 3/2- L(p,d)=0+2 implies the presence of a doublet.
3050.6 4	11/2-	E		O		<17 fs	$J\pi$: probable 1/2+ from L(p,d)=0 or 0(+2). E(level): population in ($\alpha, n\gamma$) is considered suspect (evaluators).
3076.0 15	(5/2)+	E G	JkL	Q		<17 fs	$J\pi$: L(d,t)=2 and γ to 7/2-. L(d,p)=0 gives 1/2+. L(α, d)=4+6 is inconsistent with $J=5/2$.
3096.0 7	(1/2- to 7/2-)	Ef	jkl	o		<17 fs	$J\pi$: γ to 3/2- and 5/2-.
3097.0 6	(5/2+ to 11/2+)	Ef	j	l	o	0.76 ps 21	$J\pi$: γ to 7/2+ and 9/2+.
3195.6 5	7/2+, 9/2+	E G	JKL	O		118 fs 42	$J\pi$: L(α, α')=3+5; L($\alpha, ^3\text{He}$)=4.
3270	(5/2)		kl	opq	S		$J\pi$: D+Q γ transitions to 5/2- and 7/2-; γ to 5/2+; $\alpha\gamma(2288)$ favors 5/2.
3278 10	(11/2 to 17/2)+	G	kl	opq			$J\pi$: L(α, d)=6 from 3/2+; L(α, α')=3+5. L($\alpha, ^3\text{He}$)=(4) implying (7/2+, 9/2+) is inconsistent with either of the $J\pi$ values for 3278 or 3270 levels.
3285.7 6	3/2-	Ef H J L	Opq			<60 fs	$J\pi$: L(d,p)=1. $\gamma(\text{circ pol})$ in (pol n, γ) does not allow 1/2-. L(α, α')=3+5 for 3277+3297 is inconsistent with $\pi=-$.
3315.2 7	1/2-, 3/2-	Ef H J				0.13 ps 6	$J\pi$: L(d,p)=1.
3371.19 ^a 19	13/2+	CDE G		O		<14 ps	XREF: G(3372)O(3377).
3376.6 10		E	JK				$J\pi$: L(α, α')=3+5 and $\Delta J=2$ to 9/2+ from $\gamma(\theta)$ and $\gamma(\text{lin pol})$ in ($\alpha, n\gamma$).
3415 8	5/2-, 7/2-		JKL				$T_{1/2}$: From ($^{19}\text{F}, 2pn\gamma$). >3.5 ps from ($\alpha, n\gamma$).
3469 5			O				$J\pi$: L(d,p)=L($\alpha, ^3\text{He}$)=3.
3505.3 3	13/2+	DE G	K	O		73 fs 24	$J\pi$: L(α, d)=4+6 from 3/2+; L(α, α')=3+5; $\Delta J=1$ to 11/2- from $\gamma(\theta)$ and $\gamma(\text{lin pol})$ in ($\alpha, n\gamma$).
3572.2 5	3/2-	H J					$J\pi$: L(d,p)=1. $\gamma(\text{circ pol})$ in (pol n, γ) does not allow 1/2-.
3604 10	(1/2)+	J	PQ				$J\pi, E(\text{level})$: L(d,p)=0. However, L(p,d)=2 giving 3/2+, 5/2+ may suggest a doublet near this energy.
3649 8	(3/2+, 5/2+)		JK				$J\pi$: L(d,p)=(2).
3662.5 4	13/2-	E		O		49 fs 21	$J\pi$: $\Delta J=1$ to 11/2- from $\gamma(\theta)$ and $\gamma(\text{lin pol})$ in ($\alpha, n\gamma$) and γ to 9/2-.
3705 10			J				
3737 10			J				
3772 10	1/2-, 3/2-		J				$J\pi$: L(d,p)=1.
3783 10			J				
3816.1 8	(7/2-)	E	JK			69 fs 38	XREF: K(3803).
3837 10	(3/2 to 13/2)+	G		O			$J\pi$: from L(d,p)=L($\alpha, ^3\text{He}$)=(3) and γ to 9/2+.
3864 10	(1/2-, 3/2-)		J				$J\pi$: L(α, d)=4 from 3/2+.
3898 10			J				$J\pi$: L(d,p)=(1).
3918 8	(7/2, 9/2)+	F	JK	O			E(level): possible doublet as suggested in ($\alpha, ^3\text{He}$) and in 1990En08 evaluation. See also $J\pi$ comment.
							$J\pi$: L($^3\text{He}, p$)=2 from 3/2+; L(α, α')=3+5; L($\alpha, ^3\text{He}$)=(4). L(d,p)=(1) from 1974Br19 is in disagreement but L(d,p)=4 is also suggested by 1966Do02. Similarity to 4984, 9/2+ state in ^{41}Ca indicates 4p-1h component in this level (1968Do02).

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Adopted Levels, Gammas (continued) ^{43}Ca Levels (continued)

E(level) [†]	Jπ [‡]	XREF		T _{1/2} [#]	Comments
3943.81 ^{&} 24	15/2+	CDE	G O	0.76 ps 21	Jπ: ΔJ=1 to 13/2+ from γ(θ) and γ(lin pol) in (α,nγ); L(α,d)=6 from 3/2+.
3958 10			J		
3978 10	3/2+, 5/2+		J PQ		XREF: P(3950). Jπ: L(d,p)=L(p,d)=L(d,t)=2.
4017 10			J		
4044 8	3/2+, 5/2+		JK		Jπ: L(d,p)=2.
4078 10			J		
4089 10	(5/2-, 7/2-)		J		Jπ: L(d,p)=(3).
4135.9 7	7/2+, 9/2+	E G	JK O	<260 fs	XREF: J(4124)K(4123). Jπ: L(d,p)=4; inconsistent with L(α,d)=6 from 3/2+.
4148 10	1/2+		J		Jπ: L(d,p)=0.
4174.8 11		E			
4186.5 4	15/2+	DE	G	125 fs 50	Jπ: ΔJ=1 to 13/2+ from γ(θ) and γ(lin pol) in (α,nγ); L(α,d)=6 from 3/2+.
4207.2 5	1/2-		H JK		XREF: J(4196)K(4193). Jπ: L(d,p)=L(α, ³ He)=1. γ(circ pol) in (pol n,γ) does not allow 3/2-. Not compatible with L(d,t)=2 or L(p,d)=(2,3).
4210? 20	3/2+, 5/2+		PQ		Jπ: L(d,t)=2 and L(p,d)=(2,3). E(level): this level corresponds to 4207.1 if L transfer in (d,t) and (p,d) is ignored (1978En02).
4239 10	1/2-, 3/2-		J		Jπ: L(d,p)=1.
4268 10	(3/2+, 5/2+)		J Q		Jπ: L(d,t)=2. L(d,p)=1 in 1974Br19 suggests 1/2-, 3/2-. In another experiment L(d,p)=2 is also suggested by 1966Do02.
4291 10	(7/2 to 13/2)+		G		Jπ: L(α,d)=4+6 from 3/2+.
4298 10	1/2+		J		Jπ: L(d,p)=0.
4364 10	(7/2 to 13/2)+		G J		Jπ: L(α,d)=4+6 from 3/2+.
4394.8 5	15/2-	E		42 fs 17	Jπ: ΔJ=2 to 11/2- from γ(θ) and γ(lin pol) in (α,nγ).
4401 10			J		
4461 7	5/2-, 7/2-		G JK P		Jπ: L(d,p)=3. Incompatible with (7/2 to 13/2)+ from L(α,d)=4+6 from 3/2+.
4498 10			J		
4533 10	1/2+		J		Jπ: L(d,p)=0.
4569 8			K		
4585 10			J		
4591.0 ^a 4	17/2+	CDE	G	0.21 ps 5	Jπ: ΔJ=1 to 15/2- from γ(θ) and γ(lin pol) in (α,nγ); L(α,d)=6 from 3/2+.
4603.4 10	(1/2, 3/2, 5/2+)		H J		Jπ: γ from 1/2+ capture state.
4621.2 4	15/2+	E		76 fs 28	Jπ: ΔJ=1, M1 γ to 13/2+ from γ(θ) and γ(lin pol) in (α,nγ).
4641.6 10	3/2+, 5/2+		H J		Jπ: L(d,p)=2.
4654 10	1/2+		J		Jπ: L(d,p)=0.
4703 10		G	J pq		
4736 10	3/2+, 5/2+		J pq		Jπ: L(d,t)=2.
4758 10			J		
4783 10			J		
4796 10			J		
4826 8	(5/2-, 7/2-)		JK		Jπ: L(α, ³ He)=(3).
4854 10			J		
4878 8	(7/2 to 17/2)+		G JK		Jπ: L(α,d)=6 from 3/2+.
4901.2 6	1/2-, 3/2-		H J		Jπ: L(d,p)=1. Jπ=1/2- is preferred by γ(circ pol) in (pol n,γ).
4922 10			J		
4944 10			J		
4982 10	(3/2+, 5/2+)		J		Jπ: L(d,p)=2 from 1974Br19; but L(d,p)=1 implying 1/2-, 3/2- is suggested in 1966Do02.
5004 8	(5/2-, 7/2-)		JK		Jπ: L(α, ³ He)=(3).

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued) ^{43}Ca Levels (continued)

E(level) [†]	J $\pi^{\ddagger}$	XREF	T _{1/2} [#]	Comments
5037.5 11	1/2-, 3/2-	H Jk		J π : L(d,p)=1. J π =1/2- is preferred by $\gamma(\text{circ pol})$ in (pol n, γ).
5047 10	1/2-, 3/2-	Jk		J π : L(d,p)=1.
5072 10	1/2-, 3/2-	J		J π : L(d,p)=1.
5100 10	1/2+	J		J π : L(d,p)=0.
5155.4 6	(13/2, 17/2)-	E	76 fs 28	J π : $\Delta J=1$, M1+E2 γ to 15/2-; γ to 13/2-.
5170 10	3/2+, 5/2+	J		J π : L(d,p)=2.
5189 10	(7/2 to 13/2)+	G		J π : L(α ,d)=4+6 from 3/2+.
5193 10	1/2+	JK p		J π : L(d,p)=0. L(α , ^3He)=(3) and L(p,d)=(2,3) is inconsistent.
5215 10	1/2+	J pQ		J π : L(d,p)=0. L(p,d)=(2,3) is inconsistent.
5249 8	(7/2 to 13/2)+	G K		J π : L(α ,d)=4+6 from 3/2+.
5351 10	(7/2 to 13/2)+	G Q		J π : L(α ,d)=4+6 from 3/2+.
5394.7 11	(11/2- to 19/2-)	E K	0.104 ps 31	E(level): 5410 group in (α , ^3He) may define a different level.
5430 20		P		J π : γ to 15/2-.
5548 8		K		
5555.4 ^{&} 6	(15/2, 19/2)+	DE	1.4 ps 4	J π : $\gamma(\theta, \text{pol})$ in (α ,n γ) and RUL.
5647 8		K		
5696 10	(7/2 to 13/2)+	G		J π : L(α ,d)=4+6 from 3/2+.
5728 8	3/2+, 5/2+	K PQ		J π : L(d,t)=2.
5805 8		K		
5889 8		K		
5931.5 8	(11/2 to 19/2)-	E	55 fs 17	J π : M1(+E2) stretched dipole transition to (13/2,17/2)- from $\gamma(\theta, \text{lin pol})$ in (α ,n γ).
5991 8	(5/2-, 7/2-)	K		J π : L(α , ^3He)=(3).
6015 20	1/2+	PQ		J π : L(p,d)=0. L(d,t)=(2) is inconsistent.
6087 10		G		
6177 10	(3/2+, 5/2+)	G PQ		J π : L(d,t)=(2).
6223.6 ^a 8	(17/2, 21/2)+	DE	0.58 ps 15	J π : $\Delta J=1$ stretched dipole transition to (15/2,19/2)+ from $\gamma(\theta, \text{lin pol})$ in (α ,n γ);RUL.
6300		F		
6410		F		
6460		F		
6570		F		
6640		F		
6680		F		
6790		F		
6950		F		
7040		F		
7090		F		
7190		F		
7500		F		
7590 20		F Q		
7730		F		
7920		F		
(7932.7 3)	1/2+	H		
7941.88 17	1/2-, 3/2-\$	I		
7942.08 17	1/2+\$	I		
7951.56 17	1/2-, 3/2-\$	I		
7955.13 17	1/2+\$	I		
7956.17 17	1/2-, 3/2-\$	I		
7958.62 17	1/2+\$	I		
7968.91 17	1/2-, 3/2-\$	I		
7969.51 17	1/2+\$	I		
7972.10 17	1/2-, 3/2-\$	I		
7977.9	1/2+\$	I		
7980.06 17	1/2+\$	I		
7981.48 17	1/2-, 3/2-\$	I		
7981.65 17	1/2-, 3/2-\$	I		

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued) ^{43}Ca Levels (continued)

E(level) [†]	J $\pi^{\ddagger}$	XREF		Comments
7989.92 17	1/2+ $\S$	I		
7990.20	(3/2)+	F	PQR	T=5/2. XREF: F(8033). J π : L(p,d)=L(d,t)=L($^3\text{He},\alpha$)=2. Strong L($^3\text{He},p$)=0 from 3/2+ indicates IAS of ^{43}K g.s., J π =3/2+.
7991.80 17	1/2+ $\S$	I		
7996.59 17	1/2+ $\S$	I		
8002.12 17	1/2-, 3/2- $\S$	I		
8006.45 17	1/2-, 3/2- $\S$	I		
8007.62 17	1/2+ $\S$	I		
8013.64 17	1/2+ $\S$	I		
8014.25 17	1/2-, 3/2- $\S$	I		
8020.16 17		I		
8020.52 17		I		
8023.49 19		I		
8023.77 19		I		
8025.59 19		I		
8028.55 19	1/2+ $\S$	I		
8033.83 20	1/2-, 3/2- $\S$	I		
8047.20 20	1/2+ $\S$	I		
8049.25 20	1/2-, 3/2- $\S$	I		
8052.1 10	1/2+ $\S$	I		
8055.99 20	1/2-, 3/2- $\S$	I		
8057.0 10	1/2+ $\S$	I		
8057.07 20	1/2-, 3/2- $\S$	I		
8057.46 20		I		
8058.34 20		I		
8061.1 3	1/2-, 3/2- $\S$	I		
8062.2 3	1/2+ $\S$	I		
8066.1 3	1/2-, 3/2- $\S$	I		
8073.9 3	1/2+ $\S$	I		
8074.6 3	1/2-, 3/2- $\S$	I		
8075.5 3		I		
8078.4 3	1/2+ $\S$	I		
8081.0 3		I		
8086.1 3	1/2+ $\S$	I		
8089.4 3		I		
8090.3 4		I		
8099.3 4		I		
8103.3 10	1/2+ $\S$	I		
8106.1 4	1/2+ $\S$	I		
8113.7 4		I		
8115.4 4	1/2+ $\S$	I		
8128.3 5		I		
8132.9 5		I		
8134.1 5		I		
8138.2 5		I		
8139.9 5	1/2+ $\S$	I		
8141.6 5	1/2-, 3/2- $\S$	I		
8144.3 5		I		
8149.0 5	1/2-, 3/2- $\S$	I		
8152.3 5	1/2-, 3/2- $\S$	I		
8157.2 5	1/2+ $\S$	I		
8160		F		
8165.9		I		
8176.1		I		
8181.0	1/2-, 3/2- $\S$	I		
8186.4	1/2+ $\S$	I		
8201.0	1/2+ $\S$	I		
8201.5		I		
8204.9	1/2+ $\S$	I		
8206.9	1/2-, 3/2- $\S$	I		
8223.0		I		

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Adopted Levels, Gammas (continued) ^{43}Ca Levels (continued)

E(level) [†]	$J\pi^{\ddagger}$	XREF	Comments
8259.1		I	
8263.0		I	
8270		F	
8281.1	1/2+ [§]	I	
8302.6		I	
8308.9		I	
8323.1	1/2+ [§]	I	
8341.1	1/2+ [§]	I	
8348.0	1/2+ [§]	I	
8367.5		I	
8369.5		I	
8372.9	1/2+ [§]	I	
8399.7	1/2+ [§]	I	
8412.9	1/2+ [§]	I	
8418.8		I	
8430.0		I	
8434.4	1/2+ [§]	I	
8452.5	1/2+ [§]	I	
8465.6	1/2+ [§]	I	
8470		F	
8474.9	1/2+ [§]	I	
8479.8	1/2+ [§]	I	
8484.2		I	
8490.1	1/2+ [§]	I	
8492.0		I	
8590 20	1/2+	PQ	T=5/2. J π : L(p,d)=L(d,t)=0. Possible IAS of 1/2+, 561 in ^{43}K .
8767 20	5/2-, 7/2-	PQ	T=5/2. J π : L(p,d)=L(d,t)=3. Possible IAS of 7/2-, 738 in ^{43}K .
8930		F	
8993 20	1/2-, 3/2-	PQ	T=5/2. J π : L(p,d)=L(d,t)=1. Possible IAS of 3/2-, 975 in ^{43}K .
9145 30	3/2+, 5/2+	PQ	T=5/2. J π : L(p,d)=L(d,t)=2. Possible IAS of 3/2+, 1110 in ^{43}K .
10485 30	1/2+	PQ	T=5/2. J π : L(p,d)=L(d,t)=0. Possible IAS of 1/2+, 2451 in ^{43}K .
10720 30	3/2+, 5/2+	PQ	J π : L(d,t)=2.
11380 30		PQ	
12060 30		P	
12265 30	3/2+, 5/2+	PQ	J π : L(d,t)=2.
13230 30	(3/2+, 5/2+)	PQ	J π : L(d,t)=(2).
13700 30		P	
13950 30		P	
14190 30		Q	

[†] From least-squares adjustment to measured $E\gamma$ data when such data are available. Otherwise weighted averages of available level energies are taken.

[‡] When L-transfer arguments are used, the target is $J\pi=0+$, except for $^{41}\text{K}(^3\text{He},p)$ and $^{41}\text{K}(\alpha,d)$, where target $J\pi=3/2+$.

[§] From s-wave or p-wave assignment in the analysis of neutron-resonance data (2006MuZX).

[#] From DSAM in $(\alpha,n\gamma)$, unless otherwise indicated. For levels from 7992 to 8590, see the $(n,\gamma),(n,n)$:resonances for Γ widths.

@ From DSAM. Weighted average of values in $(\alpha,n\gamma)$ and $(p,p'\gamma)$.

& (A): Band based on 3/2+.

^a (B): Band based on 5/2+.

Adopted Levels, Gammas (continued)

$\gamma(^{43}\text{Ca})$					
E(level)	$E_{\gamma}^{\dagger}$	$I_{\gamma}^{\ddagger}$	Mult. [§]	$\delta^{\S}$	Comments
372.762	372.760 7	100	M1+E2	-0.161 14	δ : 0.192 11 was deduced by 1978En02 from B(E2)= 8.7×10^{-3} 7 (1971HoYN) and $T_{1/2}=48$ ps 4. Using the same B(E2) and $T_{1/2}=34$ ps 3, evaluators get $\delta=0.161$ 14. Sign from $\gamma(\theta, \text{lin})$ in $(\alpha, n\gamma)$. $\delta=-0.15$ 3 from $(^3\text{He}, \alpha\gamma)$. B(M1)(W.u.)=0.0122 11; B(E2)(W.u.)=6.5 13.
593.394	220.632 5	42.3 8	M1+E2	-0.09 4	δ : weighted average From $\gamma(\theta)$ in $(\alpha, n\gamma)$ and $(^3\text{He}, \alpha\gamma)$. B(M1)(W.u.)=0.0075 4; B(E2)(W.u.)=4 +4-3. B(E2)(W.u.)=7.5 4.
990.257	593.390 6	100.0 4	E2		B(E1)(W.u.)= 2.31×10^{-5} 20.
	396.861 6	14.93 13	E1 (+M2)	-0.1 1	
	617.490 6	100.00 14	E1 (+M2)	-0.015 17	δ : weighted average from $\gamma(\theta)$ in $(\alpha, n\gamma)$ and $(^3\text{He}, \alpha\gamma)$. B(E1)(W.u.)= 4.1×10^{-5} 4; B(M2)(W.u.)<0.4. B(M2)(W.u.)=0.17 3.
1394.473	990.245 8	0.36 5	[M2]		B(M1)(W.u.)=0.023 5; B(E2)(W.u.)=41 14.
	404.214 13	18.7 7	M1+E2	+0.32 5	B(E1)(W.u.)= 3.2×10^{-5} 7; B(M2)(W.u.)<0.8.
	801.070 13	7.5 7	E1 (+M2)	-0.03 4	B(E1)(W.u.)=0.00021 4.
	1021.698 13	100.0 9	E1 (+M2)	+0.11 12	B(E1)(W.u.)= 7×10^{-6} 3.
	1394.448 14	9 3	E1		I_{γ} : unweighted average of 6.7 4 from β^- decay, 15.1 5 from $(\alpha, n\gamma)$ and 4.8 8 from $(p, p'\gamma)$.
1677.84	1677.8 2	100	E2 (+M3)	-0.02 2	B(E2)(W.u.)=5.6 10.
1901.99	507.8 3	24 3	[M1]		B(M1)(W.u.)=0.053 13.
	911.6 3	19 6	E2 (+M3)	-0.02 3	B(E2)(W.u.)=25 10.
	1901.8 2	100 6	E1 (+M2)	+0.03 4	B(E1)(W.u.)=0.000106 22; B(M2)(W.u.)<0.5.
1931.53	1338.3 5	11.7 11	M1+E2	+2.2 25	B(M1)(W.u.)=0.0009 +18-9; B(E2)(W.u.)=7 4.
	1558.8 2	59 2	M1+E2	+0.28 14	B(M1)(W.u.)=0.016 5; B(E2)(W.u.)=1.5 +15-11.
	1931.4 2	100 2	M1+E2	-0.8 3	B(M1)(W.u.)=0.009 4; B(E2)(W.u.)=4.6 25.
1957.4	967.1 4	28 1	[M1]		B(M1)(W.u.)=0.0048 14.
	1364.0 5	100 1	[E1]		B(E1)(W.u.)=0.00015 5.
2046.21	651.2 4	2 1	[E1]		B(E1)(W.u.)= 3.2×10^{-5} 18.
	1056.0 5	11 1	E1 (+M2)	0.00 3	B(E1)(W.u.)= 4.1×10^{-5} 11.
	1453.0 3	13 2			
	1673.5 4	32 3	[M1]		B(M1)(W.u.)=0.0012 4.
	2046.2 3	100 6	E2 (+M3)	0.00 2	B(E2)(W.u.)=1.4 4.
2067.21	1694.3 3	28.0 12	M1+E2	-0.90 24	B(M1)(W.u.)=0.026 11; B(E2)(W.u.)=21 10.
	2067.2 2	100.0 12	M1+E2	-0.10 6	B(M1)(W.u.)=0.09 3; B(E2)(W.u.)=0.6 +8-5.
2093.81	2093.8 2	100	M1+E2	-5.9 11	B(M1)(W.u.)= 4.8×10^{-5} 22; B(E2)(W.u.)=1.1 4.
2102.7	1509.2 5	50	M1+E2	+2.0 17	B(M1)(W.u.)=0.0010 +14-10; B(E2)(W.u.)=4.9 25.
	1730.0 6	100 40	[M1]		B(M1)(W.u.)=0.006 4.
	2102.8 5	50 30	[E2]		B(E2)(W.u.)=1.2 9.
2223.9	1630.4 5	100.0 23	M1+E2		δ : -0.50 25 for J=5/2; +0.8 +4-10 for J=3/2.
	1851.2 4	74.5 23	M1+E2		δ : -0.20 5 for J=5/2; >+11, or <-5.6 for J=3/2.
2249.01	570.7 5	2.3 6			
	1876.3 2	12.6 11	E2 (+M3)	-0.01 3	B(E2)(W.u.)=8.1 19.
	2248.9 2	100.0 11	M1+E2	-0.75 12	B(M1)(W.u.)=0.029 8; B(E2)(W.u.)=9 3.
2272.8	877.8 4	19 4	M1+E2		δ : -10 +4-13 for J=5/2; +0.1 4 for J=3/2.
	1283.3 5	100 4	M1+E2		δ : -11 +2-4 for J=5/2; -0.26 5 for J=3/2.
2409.68	508.0 7	24 4			I_{γ} : from $(p, p'\gamma)$.
	732 [#]	<15			
	1015.2 2	98 9	[E2]		B(E2)(W.u.)=22 8.
	2409.6 3	100 9	E1 (+M2)	-0.03 4	B(E1)(W.u.)= 1.5×10^{-5} 6; B(M2)(W.u.)<0.04.
2611.1	564.9 3	54 16	[M1]		B(M1)(W.u.)=0.33 17.
	2017.6 5	100 16	[M1]		B(M1)(W.u.)=0.013 6.
2674.3	1276.0 [#] 10				
	2301.5 8	100			
	2674.6 [#] 8				
2696.5	1706.2 6	57.7 14			
	2103.1	27 14			
	2324.4 9	100.0 14	[E1]		B(E1)(W.u.)>0.00062.
2754.00	1076.14 15	100	E2 (+M3)	-0.02 2	B(E2)(W.u.)=1.86 8.
2769.6	1779.1 6				
	2176.6 8				
2844.7	942.1 6				
	1450.2				
	2845.7 11				

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Adopted Levels, Gammas (continued) $\gamma(^{43}\text{Ca})$ (continued)

E(level)	$E\gamma^{\dagger}$	$I\gamma^{\ddagger}$	Mult. [§]	$\delta^{\S}$	Comments
2878.7	831.4 [#] 10 922.1 [#] 6 2285.2 10 2505.9 [#]				γ seen in (n, γ) only. $E\gamma$: γ seen in (α ,n γ) only. γ reported in (n, γ) and (α ,n γ). γ seen in (^3He , $\alpha\gamma$) only.
2943.5	840.9 10 1953.2 2350.3 4 2570.1 8 2943.4	12 8 35 13 100 12 100 40 12 7			
2951.33	541.5 3 857.6 3 1049.0 4	21.5 15 100.0 15 32.3 15	M1+E2 E1 (+M2) [E2]	-0.04 2 0.00 2	B(M1)(W.u.)=0.0041 11; B(E2)(W.u.)=0.06 +7-5. B(E1)(W.u.)=0.00012 3. B(E2)(W.u.)=2.2 6.
3028.7	2655.9 8	100			
3030.4	2040.1 2436.9	45 13 100			
3049.6	3049.5 [#] 15	100			
3050.6	801.7 7 1373.0 6 3049.7 11	23 2 100 4 69 4	[M1] M1+E2 E2 (+M3)	 +0.30 5 -0.02 2	B(M1)(W.u.)>0.30. B(M1)(W.u.)>0.23; B(E2)(W.u.)>23. B(E2)(W.u.)>5.1.
3076.0	3075.9 15	100			
3096.0	2502.4 8 2723.4 11				
3097.0	687.3 7 1195.0 10				
3195.6	350.7 4 1294.1 7				
3270	1876 [#] 2280 [#] 3270 [#]	35 100 69	D+Q D(+Q)	 +0.07 5 -0.13 13	
3285.7	1239.6 9 2692.2 2912.8	100 30 50 20 50 20	[M1]		B(M1)(W.u.)>0.096. $I\gamma$: quoted by 1978En02. $I\gamma$: quoted by 1978En02.
3315.2	1269.0 6	100	[M1]		B(M1)(W.u.)=0.08 4.
3371.19	419.6 3 617.1 7 961.6 2 1693.7 9	51 3 63 3 100 3 29 3	E2 (+M3)	0.00 2	B(E2)(W.u.)>2.3.
3376.6	1282.8 9				
3505.3	554.1 5 751.1 6 1827.4 9	16 3 17 3 100 3	M1+E2 [E1] E1 (+M2)	-0.06 2 -0.03 3	B(M1)(W.u.)=0.21 8; B(E2)(W.u.)=7 6. B(E1)(W.u.)=0.0023 9. B(M2) $\downarrow$ =1.1 11. B(E1)(W.u.)=0.0009 3; B(M2)(W.u.)<3.5.
3572.2	1525.4 10 2978.9 7 3199.3	58 17 100 25 25 17			
3662.5	612.0 7 908.0 9 1412.9 7 1984.8 9	20 3 21 3 23 3 100 3	[M1] [M1] [E2] M1+E2	 -0.60 14	B(M1)(W.u.)=0.24 11. B(M1)(W.u.)=0.08 4. B(E2)(W.u.)=32 15. B(M1)(W.u.)=0.026 12; B(E2)(W.u.)=7 3.
3816.1	1406.4 7	100			
3943.81	438.5 4 572.6 2 993	100 14 67 14	M1 (+E2) [M1]	0.00 2	B(M1)(W.u.)=0.18 6. B(M1)(W.u.)=0.053 20. $E\gamma$: from (^{18}O , α n γ). B(E1)(W.u.)=6. $\times 10^{-5}$ 4.
4135.9	1189.8 7 1184.6 6	29 14 100	[E1]		
4174.8	1902.0 10	100			
4186.5	681.1 4 815.4 6	16 4 100 4	[M1] M1+E2	 -0.15 2	B(M1)(W.u.)=0.08 4. B(M1)(W.u.)=0.27 11; B(E2)(W.u.)=27 13.
4207.2	2161.1 6 3613.4 8	45 13 100 23			
4394.8	731.9 5 1641.1 7 2717.4 12	54 7 90 7 100 7	[M1] M1+E2 E2 (+M3)	 -0.50 14 0.00 2	B(M1)(W.u.)=0.30 13. B(M1)(W.u.)=0.035 15; B(E2)(W.u.)=9 6. B(E2)(W.u.)=4.2 18.

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued) $\gamma(^{43}\text{Ca})$ (continued)

E(level)	$E\gamma^\dagger$	$I\gamma^\ddagger$	Mult.§	$\delta^\S$	Comments
4591.0	404.4 4	49 10	[M1]		B(M1)(W.u.)=0.38 13.
	647.2 3	100 10	M1(+E2)	0.00 2	B(M1)(W.u.)=0.19 6.
	1837.4 9	55 10	E1(+M2)	0.00 2	B(E1)(W.u.)=0.00011 4.
4603.4	4009.8 #				
4621.2	677.4 4	39 6	[M1]		B(M1)(W.u.)=0.26 11.
	1249.9 7	100 6	M1(+E2)	-0.02 3	B(M1)(W.u.)=0.11 4; B(E2)(W.u.)<0.3.
4641.6	2595.3 #				
4901.2	2628.3	67 33			
	2798.4	100 67			
	2854.9	100 50			
	4307.6	67 50			
5037.5	2992.4 10				
5155.4	760.4 5	100 5	M1+E2	-0.11 4	δ : from -0.15 2 (for $J\pi=13/2^-$) and -0.08 2 (for $J\pi=17/2^-$). B(M1)(W.u.)=0.42 16; B(E2)(W.u.)=25 21.
	1493.1 5	54 5			
5394.7	2640.6 10	100			
5555.4	964.5 6	66			
	1611.4 7	100	M1, E2		
5931.5	776.1 5	100	M1(+E2)		B(M1)(W.u.)<0.9.
6223.6	668.2 5	100	M1(+E2)		
(7932.7)	2895.1 5	3.8 6			
	3031.3 10	2.1 6			
	3291.1				
	3330.0				
	3725.3 3	15.7 32			
	4359.5 5	5.5 8			
	4616.6 9	1.1 6			
	4646.2 6	4.5 9			
	4989.2 5	6.8 9			
	5054.2 5	4.5 8			
	5321.4 5	7.7 11			
	5828.6 15	1.7 6			
	5886.0 4	100 15			
	5975.2 15	1.1 6			
	7339.0 7	10.8 17			

[†] From weighted average of measured $E\gamma$ values in different reactions and decays, when such data are available. Otherwise, the values represent level-energy differences.

[‡] Weighted average of available data from different reactions.

[§] From $\gamma(\theta, \text{pol})$ in $(\alpha, n\gamma)$ and $(^3\text{He}, \alpha\gamma)$, unless otherwise noted.

Placement of transition in the level scheme is uncertain.

^{43}K β^- Decay (22.3 h) 1988Wa28,1972Wa20

Parent ^{43}K : $E=0$; $J\pi=3/2+$; $T_{1/2}=22.3$ h I ; $Q(\text{g.s.})=1833.4$ 5; % β^- decay=100.

^{43}K -J, $T_{1/2}$: From Adopted Levels of ^{43}K .

^{43}K -Q(β^-): From 2012Wa38.

1988Wa28: ^{43}K was produced via the $^{44}\text{Ca}(\text{t},\alpha)$ reaction with tritons of 3.2 MeV from the Brookhaven National Laboratory Van de Graaff accelerator. γ -rays were detected by a Ge(Li) detector. Measured $E\gamma$, $I\gamma$, β^- spectra. Deduced levels, β^- and γ branching ratios. Shell-model calculations.

1972Wa20: measured $E\gamma$, $I\gamma$, $T_{1/2}$.

Others:

γ : 1970La11, 1969Ta07, 1968Ch12, 1967Cl05, 1959Be72, 1957Ba07, 1955Ne01, 1954Li42.

β^- : 1959Be72, 1954Li42, 1949Ov01.

$\gamma\gamma$: 1957Ba07, 1959Be72.

$\beta\gamma$: 1959Be72.

$\beta\gamma(\text{t})$: 1970Ho26.

$\gamma\gamma(\theta)$, $\beta\gamma(\theta)$: 1957Li39.

$T_{1/2}$ and isotopic assignment: 1972Em01, 1963Ho17, 1954An25, 1954Li42, 1954Co70, 1949Ov01.

 ^{43}Ca Levels

$E(\text{level})^\dagger$	$J\pi^\ddagger$
0.0	7/2-
372.762 5	5/2-
593.394 5	3/2-
990.257 5	3/2+
1394.473 8	5/2+

† From least-squares fit to $E\gamma$ data.

‡ From Adopted Levels.

 β^- radiations

$E\beta^-$	$E(\text{level})$	$I\beta^-^\dagger$	$\text{Log } ft$	Comments
(438.9 5)	1394.473	2.60 4	6.10 1	
(843.1 5)	990.257	90.9 6	5.60 1	
(1240.0 5)	593.394	4.06 13	7.60 2	
(1460.6 5)	372.762	0.9 6	8.5 3	$I\beta^-$: from 1988Wa28.
(1833.4 5)	0.0	1.54 18	9.73 ^{1u} 5	From magnetic spectrometer measurements (1988Wa28), the Kurie plot has the expected unique first-forbidden shape. $I\beta^-$: from $I\beta(\text{g.s.})/I\beta(990)=0.017$ 2 (adopted by 1988Wa28 as the average of 0.019 (1954Li42) and 0.015 (1959Be72)).

† Absolute intensity per 100 decays.

 $\gamma(^{43}\text{Ca})$

$I\gamma$ normalization: $I(\gamma+\text{ce})(\gamma\text{ s to g.s.})=98.46$ 18. $I\beta(\text{g.s.})=1.54$ 18.

$E\gamma^\dagger$	$E(\text{level})$	$I\gamma^\ddagger$ #	Mult. §	δ §
220.632 5	593.394	5.53 7	M1+E2	-0.09 4
372.760 [‡] 7	372.762	100.0	M1+E2	-0.161 14
396.861 6	990.257	13.65 9	E1(+M2)	-0.1 1
404.214 13	1394.473	0.420 15	M1+E2	+0.32 5
593.390 6	593.394	12.97 9	E2(+M3)	≈ 0.0
617.490 6	990.257	91.2 7	E1(+M2)	-0.015 17
801.070 13	1394.473	0.170 15	E1(+M2)	-0.03 4
990.245 8	990.257	0.33 4		
1021.698 13	1394.473	2.26 3	E1(+M2)	+0.11 12
1394.448 14	1394.473	0.151 9	E1(+M2)	≈ 0.0

† From 1988Wa28.

‡ Recoil correction removed from $E\gamma=372.762$ (1988Wa28).

§ From Adopted Gammas.

For absolute intensity per 100 decays, multiply by 0.868 2.

^{43}K β^- Decay (22.3 h) 1988Wa28,1972Wa20 (continued) **^{43}Sc ϵ Decay (3.891 h) 1975Yo03**

Parent ^{43}Sc : $E=0$; $J\pi=7/2^-$; $T_{1/2}=3.891$ h 12; $Q(\text{g.s.})=2220.7$ 19; $\% \epsilon + \% \beta^+$ decay=100.

$^{43}\text{Sc}-J, T_{1/2}$: From Adopted Levels of ^{43}Sc .

$^{43}\text{Sc}-Q(\epsilon)$: From 2012Wa38.

1975Yo03: Activity of ^{43}Sc was produced via the $^{40}\text{Ca}(\alpha, p)$ reaction using a 12 MeV α beam from the University of Pennsylvania tandem accelerator. γ -rays were detected using a 65 cm³ Ge(Li) detector. Measured E_γ, I_γ . Deduced levels, branchings.

Others:

γ : 1968Ch12, 1964Ba46, 1954Li42, 1954Nu22, 1953Nu08, 1952Ha44.

β^+ : 1964Ba46, 1954Li42, 1952Ha44, 1945Hi04, 1945Hi05.

$\beta\gamma$: 1954Li42.

$T_{1/2}$ and isotopic assignment: 1969Ra16, 1963Du11, 1945Hi05, 1945Hi04. Others: 1954An25, 1953Du22, 1952Ha44, 1940Wa01, 1937Wa07, 1935Fr04.

All data are from 1975Yo03, unless otherwise noted.

 ^{43}Ca Levels

$E(\text{level})^\dagger$	$J\pi^\ddagger$
0.0	7/2-
372.9 3	5/2-
593.2 5	3/2-
1931.0 4	5/2-

[†] From least-squares fit to E_γ data.

[‡] From Adopted Levels.

 β^+, ϵ Data

$E\epsilon$	$E(\text{level})$	$I\beta^{+\dagger}$	$I\epsilon^\dagger$	Log ft	$I(\epsilon+\beta^+)^\dagger$	Comments
(289.7 20)	1931.0		0.0253 10	5.68 2	0.0253 10	
(1847.8 20)	372.9	17.2 5	5.33 17	4.98 2	22.5 7	
(2220.7 19)	0.0	70.9 6	6.64 9	5.04 1	77.5 7	$I(\epsilon+\beta^+)$: from $I(\gamma^\pm)=783$ 24 relative to $I(373\gamma)=100$ (1975Yo03).

[†] Absolute intensity per 100 decays.

^{43}Sc ϵ Decay (3.891 h) 1975Yo03 (continued) $\gamma(^{43}\text{Ca})$

I_γ normalization: $I(\gamma+\text{ce})(\gamma\text{ s to g.s.})=22.5$ 7. Total $\epsilon+\beta^+$ feeding to g.s.=77.5 7 deduced by 1975Yo03 from $I(\gamma^2)=783$ 24 relative to $I(373\gamma)=100$. Other $\%\epsilon+\beta^+=78$ (quoted by 1975Yo03 from 1963Du11).

E_γ	E(level)	$I_\gamma^\S$	Mult. [†]	$\delta^\dagger$	Comments
(220.4)	593.2	0.0040 [‡] 14	M1+E2	-0.09 4	
372.9 3	372.9	100	M1+E2	-0.161 14	
593.3 7	593.2	0.0095 32	E2		$\delta(\text{M3/E2})=0$.
1337.9 7	1931.0	0.0080 10			
1558.3 6	1931.0	0.0375 22	M1+E2	+0.28 14	
1930.7 6	1931.0	0.0672 34	M1+E2	-0.8 3	

[†] From Adopted Gammas.[‡] Normalized from Adopted branching.[§] For absolute intensity per 100 decays, multiply by 0.225 7.

Decay Scheme

$^{27}\text{Al}(^{19}\text{F}, 2\text{pn}\gamma)$ 1976Po03 Includes $^{28}\text{Si}(^{18}\text{O}, \text{n}2\text{p}\gamma)$ from 1974Li06.

1976Po03 (also 1974Po10): E=40 MeV ^{19}F beam was produced at the Brookhaven National Laboratory. Target of aluminum evaporated onto a tungsten backing. γ -rays were detected by Ge(Li) detectors. Measured E_γ , I_γ , $\gamma\gamma$, $\gamma(\theta)$, $\gamma(\text{lin pol})$. Deduced levels, $T_{1/2}$ by recoil distance method. 1974Po10 also use $^{27}\text{Al}(^{18}\text{O}, \text{pn}\gamma)$ E=30 MeV reaction.

1974Li06: $^{28}\text{Si}(^{18}\text{O}, \text{n}2\text{p}\gamma)$. Measured $T_{1/2}$ by recoil-distance method for the level at 2755 keV.

 ^{43}Ca Levels

E(level)	$J\pi^\dagger$	$T_{1/2}^\ddagger$	E(level)	$J\pi^\dagger$	$T_{1/2}^\ddagger$	E(level)	$J\pi^\dagger$	$T_{1/2}^\ddagger$
0.0	7/2-		1677.80 20	11/2-		2951.5# 3	11/2+	<14 ps
372.81 5	5/2-		1901.80# 20	7/2+		3371.2# 4	13/2+	<14 ps
593.39 8	3/2-		2093.90 20	9/2-		3943.8# 5	15/2+	<3.5 ps
990.32# 7	3/2+	51 ps 8	2409.80# 20	9/2+		4591.0# 6	17/2+	
1394.60# 9	5/2+		2753.96 25	15/2-	23.6 ps [§] 10			

[†] From Adopted Levels.[‡] Recoil-distance method in 1976Po03, unless otherwise noted.[§] 27 ps 4 from 1974Li06.

(A): 3/2+ band.

$^{27}\text{Al}(^{19}\text{F}, 2\text{pn}\gamma)$ 1976Po03 (continued) $\gamma(^{43}\text{Ca})$

When $A_4=0$, it indicates that the fit was not improved by the inclusion of P_4 term.

$E\gamma^\dagger$	E(level)	I_γ	Comments
220.58	593.39	1.33	$A_2=-0.11$ 5, $A_4=0$.
372.81	372.81	≈ 24.0	
396.93	990.32	1.70	
404.15	1394.60	1.98	$A_2=-0.25$ 5, $A_4=0$.
419.7 3	3371.2	2.50	$A_2=-0.16$ 12, $A_4=0$. Pol= -0.41 13.
541.6 3	2951.5	0.98	$A_2=-0.46$ 19, $A_4=0$.
572.64 20	3943.8	4.03	$A_2=-0.25$ 5, $A_4=0$. Pol= -0.08 5.
617.23	3371.2	≈ 1.3	
617.51	990.32	6.44	$A_2=-0.21$ 4, $A_4=0$. Pol= $+0.11$ 9.
647.2 3	4591.0	1.35	$A_2=-0.17$ 7, $A_4=0$.
857.65 25	2951.5	3.30	$A_2=-0.09$ 10, $A_4=0$.
911.49	1901.80	≈ 0.63	$A_2=+0.28$ 2, $A_4=-0.16$ 2. Pol= $+0.53$ 14.
961.60 20	3371.2	4.13	$A_2=+0.23$ 5, $A_4=-0.10$ 5.
1015.19	2409.80	≈ 3.6	$A_2=+0.35$ 2, $A_4=-0.12$ 2. Pol= $+0.19$ 15.
1021.78	1394.60	4.15	$A_2=+0.08$ 4, $A_4=0$.
1049.1 4	2951.5	≈ 1.0	
1076.15 15	2753.96	27.0	$A_2=+0.25$ 2, $A_4=-0.11$ 2. Pol= $+0.43$ 7.
1677.76	1677.80	47 16	$A_2=+0.23$ 2, $A_4=-0.08$ 2 for unresolved γ . Pol= $+0.30$ 8.
1693.36	3371.2	≈ 1.0	
1901.75	1901.80	3.40	$A_2=+0.17$ 6, $A_4=-0.13$ 6.
2093.85	2093.90	< 8.5	$A_2=-0.11$ 3, $A_4=+0.11$ 3. Pol= -0.05 22.
2409.73	2409.80	3.71	$A_2=-0.23$ 5, $A_4=0$.

† From level-energy differences, when no uncertainty is quoted.

 $^{30}\text{Si}(^{18}\text{O}, \alpha\gamma)$ 1998Be29

1998Be29 (also 1997Be09, 1996Be39): E=60 MeV ^{18}O beam was produced from the XTU Tandem of Laboratori Nazionali di Legnaro (LNL). Target of 360 $\mu\text{g}/\text{cm}^2$ SiO_2 . γ -rays were detected in the multi-detector 4 π GASP array of 36 Compton-suppressed HPGe detectors and 80 BGO detectors and heavy recoils were separated by the Recoil Mass Spectrometer (RMS). Measured $E\gamma$, I_γ , $\gamma\gamma$. Deduced levels.

 ^{43}Ca Levels

E(level)	$J\pi^\dagger$	E(level)	$J\pi^\dagger$	E(level)	$J\pi^\dagger$
0.0	7/2-	1902 ‡ 1	7/2+	3505 1	13/2+
373 1	5/2-	2094 1	9/2-	3944 ‡ 1	15/2+
593 1	3/2-	2410 § 1	9/2+	4187 1	15/2+
990 ‡ 1	3/2+	2754 1	15/2-	4591 § 1	17/2+
1394 § 1	5/2+	2951 ‡ 1	11/2+	5555 ‡ 1	(19/2+)
1678 1	11/2-	3371 § 1	13/2+	6223 § 2	(21/2+)

† As proposed by 1998Be29 and 1996Be39 based on DCO ratio analysis.

‡ (A): 3/2+ band.

§ (B): 5/2+ band.

 $\gamma(^{43}\text{Ca})$

$E\gamma$	E(level)	I_γ	$E\gamma$	E(level)	I_γ	$E\gamma$	E(level)	I_γ
220	593	1.0	508	1902	1.2	617	3371	4.9
373	373	33.9		2410	1.2	647	4591	9.6
397	990	3.6	541	2951	2.9	668	6223	5.4
404	1394	2.6	554	3505	1.9	751	3505	3.6
	4591	2.9	573	3944	19.6	801	1394	0.3
420	3371	6.5	593	593	2.0	815	4187	4.6
439	3944	2.0	617	990		857	2951	10.5

Continued on next page (footnotes at end of table)

³⁰Si(¹⁸O,α γ) ¹⁹⁹⁸Be29 (continued)

 $\gamma(^{43}\text{Ca})$ (continued)

E γ	E(level)	I γ	E γ	E(level)	I γ	E γ	E(level)	I γ
912	1902	1.1	1021	1394	10.1	1678	1678	100
961	3371	14.0	1049	2951	1.0	1837	4591	4.5
964	5555	12.3	1076	2754	75.4	2094	2094	13.9
993	3944	1.9	1190	3944	4.5	2410	2410	7.5
1016	2410	8.2	1611	5555	18.6			

⁴⁰Ar(α,n γ) ¹⁹⁷⁹Be27

¹⁹⁷⁹Be27 (also ¹⁹⁷⁸Be16): E=5.5–19 MeV α beam was produced at the Oliver Lodge Laboratory of University of Liverpool. Target of solid natural argon (3–5 mg/cm²) on 250 μ m thick Au or Ta backings. γ -rays were detected in a Ge(Li) detector. Measured E γ , I γ , $\gamma\gamma$, $\gamma(\theta)$, $\gamma(\text{lin pol})$. Deduced levels, J, π , γ -branching ratios, T_{1/2} by DSAM.

Others:

¹⁹⁷⁴Sc09: E=8.5 MeV. Measured T_{1/2} by DSAM.

¹⁹⁷²Al12: E=13.5 MeV. Measured E γ , I γ , $\gamma\gamma$, $\gamma(\theta)$.

¹⁹⁷²Bi13: E=5.5–8 MeV. Measured γ , ce, T_{1/2} by DSAM.

¹⁹⁷²Ka41, ¹⁹⁶⁹Ka18: E=6.3–8.0 MeV. Measured T_{1/2} by DSAM.

¹⁹⁷⁶Fi08: ⁴⁰Ar(α,n) E=24.1 MeV. Measured $\sigma(E_n, \theta)$.

¹⁹⁸⁷Wa29: ⁴⁰Ar(α,n) E=26 MeV. Measured $\sigma(E_n, \theta)$.

⁴³Ca Levels

A 1984.8 level (decaying by a 1985 γ) proposed by ¹⁹⁷²Al12 is not supported by the $\gamma\gamma$ coin and excitation function data of ¹⁹⁷⁹Be27. From $\gamma\gamma$ data, the 1985 γ is assigned by ¹⁹⁷⁹Be27 from the 3663 level.

E(level) [†]	J $\pi^{\ddagger}$	T _{1/2} ^{&}	Comments
0.0	7/2–		
372.76 14	5/2–	34 ps 3	T _{1/2} : weighted average of 29 ps 6 (¹⁹⁷⁴ Sc09), 35 ps 3 (¹⁹⁷² Bi13).
593.48 14	3/2–	81 ps 4	T _{1/2} : weighted average of 98 ps 10 (¹⁹⁷⁴ Sc09), 80 ps 4 (¹⁹⁷² Bi13), 71 ps 9 (¹⁹⁷² Ka41).
990.31 18	3/2+	48 ps 4	T _{1/2} : weighted average of 64 ps 7 (¹⁹⁷⁴ Sc09), 46 ps 3 (¹⁹⁷² Bi13), 45 ps 6 (¹⁹⁷² Ka41).
1394.78 20	5/2+	2.4 ps 8	T _{1/2} : other: 3.4 ps 6 (¹⁹⁷² Ka41).
1677.7 4	11/2–	1.5 ps 9	
1902.06 25	7/2+	0.50 ps 13	
1931.85 24	5/2–	0.125 ps 35	
1957.4 4	1/2+	1.07 ps 32	
2046.1 3	3/2–	0.83 ps 24	
2067.5 5	7/2–	<28 fs	T _{1/2} : other: <12 ps (¹⁹⁷² Ka41).
2094.0 5	9/2–	1.5 ps 4	
2102.8 4	3/2–	0.33 ps 9	
2223.8 4	(3/2, 5/2)–	28 fs 17	
2249.4 4	9/2–	24 fs 17	
2273.0 4	(3/2, 5/2)+	0.28 ps 8	
2409.8 4	9/2+	1.1 ps 4	
2611.1 4		0.13 ps 5	
2675.0 8		87 fs 42	
2696.9 6		<38 fs	
2753.9 5	15/2–		
2769.7 5		0.10 ps 4	
2844.8 5		0.55 ps 15	
2879.2 6		0.107 ps 38	
2943.6 5		<60 fs	
2951.3 4	11/2+	4.7 ps 12	
3028.7 9		<60 fs	
3049.6 15		<60 fs	
3050.7 5	11/2–	<17 fs	
3076.0 15		<17 fs	
3096.1 7		<17 fs	
3097.1 7		0.76 ps 20	
3195.7 5		0.12 ps 4	

Continued on next page (footnotes at end of table)

$^{40}\text{Ar}(\alpha, n\gamma)$ $^{1979}\text{Be}27$ (continued) **^{43}Ca Levels (continued)**

E(level) [†]	$J\pi^{\ddagger}$	$T_{1/2}^{\&}$	E(level) [†]	$J\pi^{\ddagger}$	$T_{1/2}^{\&}$
3286.0 10		<60 fs	4186.4 5	15/2+	0.13 ps 5
3315.6 11		0.13 ps 6	4394.8 6	15/2-	42 fs 17
3371.1 4	13/2+	>3.5 ps	4590.8 5	17/2+	0.21 ps 5
3376.8 10			4621.0 6	15/2+	76 fs 28
3505.2 5	13/2+	73 fs 24	5155.4 6	13/2-, 17/2-§	76 fs 28
3662.5 5	13/2-	49 fs 21	5394.6 11		0.104 ps 31
3816.2 8		69 fs 38	5555.2 7	(15/2, 19/2)+	1.4 ps 4
3943.6 5	15/2+	0.76 ps 21	5931.5 8	(11/2, 15/2, 19/2)-#	55 fs 17
4135.9 7		<0.26 ps	6223.4 9	(17/2, 21/2)+@	0.58 ps 15
4175.0 11					

[†] From least-squares fit to E γ data.[‡] From $\gamma(\theta)$ and $\gamma(\text{lin pol})$ (1979Be27).§ No observed transitions to $J \leq 11/2$ and excitation function favors 17/2.# No observed transitions to $J < 11/2$ and excitation function favors 19/2.@ No observed transitions to $J < 13/2$ and excitation function favors 21/2.

& From DSAM method (1979Be27) unless otherwise noted.

 $\gamma(^{43}\text{Ca})$

E(level)	E γ	I_{γ}	Mult. [†]	$\delta^{\ddagger}$	Comments
372.76	372.7 2	100	M1+E2	-0.161 14	Mult., δ : from Adopted Gammas; sign(δ) from $\gamma(\theta, \text{pol})$. $A_2=+0.01$ 1, $A_4=-0.02$ 1. Pol=-0.06 1.
593.48	220.7 2	29.1 5	M1 (+E2)	-0.07 7	$A_2=+0.01$ 1, $A_4=-0.03$ 1. Pol=-0.08 3.
	593.5 2	70.9 5	E2		$A_2=+0.08$ 1, $A_4=-0.02$ 1. Pol=+0.08 1. $\delta(\text{O/Q})=0$.
990.31	396.9 2	12.6 3	E1		$\delta(\text{M2/E1})=-0.1$ 1. $A_2=+0.07$ 1, $A_4=-0.02$ 1. Pol=-0.16 5.
	617.1 4	87.4 3	E1		$\delta(\text{M2/E1})=-0.02$ 2. $A_2=-0.05$ 1, $A_4=+0.01$ 1. Pol=+0.09 1.
1394.78	404.3 3	11.7 4	M1+E2	+0.32 5	$A_2=+0.14$ 1, $A_4=+0.02$ 1. Pol=-0.47 6.
	801.2 4	5.7 4	E1		$\delta(\text{M2/E1})=-0.03$ 4. $A_2=-0.21$ 2, $A_4=+0.02$ 2. Pol=+0.35 12.
	1021.6 4	77.6 4	E1		$\delta(\text{M2/E1})=+0.11$ 12. $A_2=+0.25$ 1, $A_4=-0.02$ 1. Pol=-0.31 3.
	1394.8 4	11.7 4	E1		$\delta(\text{M2/E1})=0$. $A_2=-0.25$ 3, $A_4=+0.09$ 3. Pol=+0.12 19.
1677.7	1677.7 6	100	E2		$\delta(\text{O/Q})=-0.02$ 2. $A_2=+0.33$ 2, $A_4=-0.10$ 2. Pol=+0.53 2.
1902.06	507	17 4			$\delta(\text{O/Q})=-0.02$ 3.
	911.6 3	13 4	E2		$A_2=+0.54$ 4, $A_4=-0.25$ 4.
	1902.1 5	70 $\frac{1}{2}$ 4	E1		$\delta(\text{M2/E1})=+0.03$ 4. $A_2=+0.33$ 1, $A_4=-0.01$ 1. Pol=-0.45 12.
1931.85	1338.4 5	6.6 10	M1+E2	+2.2 25	$A_2=+0.52$ 8, $A_4=+0.12$ 7.
	1559.6 5	35.1 10	M1+E2	+0.28 14	$A_2=+0.43$ 2, $A_4=-0.03$ 1. Pol=+0.48 17.
	1931.6 3	58.3 10	M1+E2	-0.8 3	$A_2=+0.31$ 1, $A_4=+0.02$ 1. Pol=-0.36 12.
1957.4	967.1 4	28 1			
	1364.0 5	100 1			
2046.1	651.0 4	2			
	1056.0 5	7	E1		$\delta(\text{M2/E1})=0.00$ 3. $A_2=+0.40$ 5, $A_4=-0.11$ 4.
	1451	8			
	1675	20			
	2046.6 9	63 $\frac{1}{2}$	E2		$\delta(\text{O/Q})=0.00$ 2. $A_2=+0.08$ 1, $A_4=0.00$ 1. Pol=+0.25 7.
2067.5	1694.7 6	21.9 9	M1+E2	-0.90 24	$A_2=-0.94$ 3, $A_4=+0.12$ 3. Pol=+0.25 11.
	2067.5 6	78.1 9	M1+E2	-0.10 6	$A_2=+0.32$ 1, $A_4=+0.01$ 1. Pol=+0.96 12.
2094.0	2094.2 8	100	M1+E2	-5.9 11	$A_2=-0.19$ 2, $A_4=+0.16$ 2. Pol=+0.09 5.
2102.8	1509.2 5	25	M1+E2	+2.0 17	δ : +0.3 to +3.7. $A_2=+0.27$ 2, $A_4=-0.05$ 3. Pol=-0.03 12.

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$^{40}\text{Ar}(\alpha, n\gamma)$ 1979Be27 (continued) $\gamma(^{43}\text{Ca})$ (continued)

E(level)	E γ	I γ	Mult. [†]	$\delta^{\dagger}$	Comments
2102.8	1730.1 6	50			$A_2=+0.09$ 2, $A_4=-0.07$ 2. Pol= -0.20 8.
	2102.9 5	25			
2223.8	1630.3 5	57.3 13	M1+E2		δ : -0.50 25 for J=5/2; $+0.8$ $+4-10$ for J=3/2. $A_2=-0.48$ 1, $A_4=+0.01$ 1. Pol= $+0.01$ 5.
	1851.0 6	42.7 13	M1+E2		δ : -0.20 5 for J=5/2; $>+11$, or <-5.6 for J=3/2. $A_2=+0.11$ 2, $A_4=+0.01$ 2. Pol= $+0.35$ 9.
2249.4	1876.8 6	11 1	E2		$\delta(\text{O/Q})=-0.01$ 3. $A_2=+0.40$ 6, $A_4=-0.34$ 8. Pol= $+1.0$ 5.
	2249.5 7	89 1	M1+E2	-0.75 12	$A_2=-0.85$ 2, $A_4=+0.05$ 3. Pol= $+0.15$ 7.
2273.0	877.8 4	16 3	M1+E2		δ : -10 $+4-13$ for J=5/2; $+0.1$ 4 for J=3/2. $A_2=-0.10$ 1, $A_4=0.00$ 1. Pol= -0.05 3.
	1283.3 5	84 3	M1+E2		δ : -11 $+2-4$ for J=5/2; -0.26 5 for J=3/2. $A_2=+0.01$ 2, $A_4=-0.03$ 2. Pol= $+0.24$ 8.
2409.8	508.0 7	11 $\frac{8}{2}$			
	1015	44 $\frac{8}{4}$			
	2409.8 6	45 $\frac{2}{4}$	E1		$\delta(\text{M2/E1})=-0.03$ 4. $A_2=-0.26$ 1, $A_4=+0.01$ 1. Pol= $+0.15$ 10.
2611.1	565.0 3				
	2017.5 6				
2675.0	2302.2 7				
	2674.6 [#] 8				γ not seen in (p,p' γ).
2696.9	1706.2 6	36.6 9			
	2324.9 9	63.4 9			$A_2=+0.26$ 2, $A_4=+0.02$ 2. Pol= -0.61 12.
2753.9	1076.0 5	100	E2		$\delta(\text{O/Q})=-0.02$ 2. $A_2=+0.36$ 1, $A_4=-0.14$ 1. Pol= $+0.60$ 3.
2769.7	1779.1 6				
	2176.6 8				
2844.8	750.9 [#]				γ treated as uncertain (by evaluators) in view of adopted $J\pi(2844)= (5/2)^+$ and $J\pi(2094)=9/2^-$.
	942.1 6				
	1450.0				
	2845.7 11				
2879.2	922.1 6				
	2285.0 10				
2943.6	2350.4 6				
	2570.1 8				
2951.3	541.5 3	14 1	M1+E2	-0.04 2	$A_2=-0.16$ 1, $A_4=+0.03$ 1. Pol= -0.20 13.
	857.4 4	65 1	E1		$\delta(\text{M2/E1})=0.00$ 2. $A_2=-0.15$ 1, $A_4=+0.01$ 1. Pol= $+0.39$ 3.
	1048.9 5	21 1			
3028.7	2655.9 8	100			$A_2=+0.32$ 2, $A_4=-0.05$ 2. Pol= $+0.48$ 10.
3049.6	3049.5 15	100			
3050.7	801.7 7	12 2			
	1373.0 6	53 2	M1+E2	$+0.30$ 5	$A_2=+0.42$ 2, $A_4=-0.02$ 1. Pol= $+0.50$ 10.
	3049.7 11	36 2	E2		$\delta(\text{O/Q})=-0.02$ 2.
3076.0	3075.9 15	100			$A_2=+0.37$ 2, $A_4=-0.04$ 2. Pol= -0.50 16.
3096.1	2502.4 8				
	2723.4 11				
3097.1	687.3 7				
	1195.0 10				Pol= $+0.45$ 10.
3195.7	350.7 4				
	1294.1 7				
3286.0	1239.9 9				
3315.6	1269.5 10				
3371.1	419.5 5	21.0 12			
	617.1 7	26.0 12			
	961.6 8	41.0 12	E2		$\delta(\text{O/Q})=0.00$ 2. $A_2=+0.27$ 2, $A_4=-0.13$ 2. Pol= $+0.55$ 7.
	1693.7 9	12.0 12			
3376.8	1282.8 9				
3505.2	554.1 5	12 2	M1+E2	-0.06 2	$A_2=-0.30$ 3, $A_4=-0.07$ 4. Pol= 0.00 3.
	751.1 6	13 2			

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$^{40}\text{Ar}(\alpha, n\gamma)$ 1979Be27 (continued) $\gamma(^{43}\text{Ca})$ (continued)

E(level)	E γ	I γ	Mult. [†]	$\delta^{\dagger}$	Comments
3505.2	1827.4 9	75 2	E1		$\delta(\text{M2/E1})=-0.03$ 3. $A_2=-0.15$ 1, $A_4=0.00$ 1. Pol=+0.41 6.
3662.5	612.0 7	12 2			
	908.0 9	13 2			
	1412.9 7	14 2			
	1984.8 9	61 2	M1+E2	-0.60 14	$A_2=-0.92$ 3, $A_4=+0.11$ 4. Pol=-0.03 10.
3816.2	1406.4 7				
3943.6	438.5 4	51 7	M1 (+E2)	0.00 2	$A_2=-0.24$ 2, $A_4=-0.01$ 2. Pol=-0.34 5.
	572.2 6	34 7			
	1189.8 7	15 7			
4135.9	1184.6 6				
4175.0	1902.0 10				
4186.4	681.1 4	14 3			
	815.4 6	86 3	M1+E2	-0.15 2	$A_2=-0.50$ 2, $A_4=-0.01$ 2. Pol=-0.28 5.
4394.8	731.9 5	22 3			
	1641.1 7	37 3	M1+E2	-0.50 14	$A_2=+0.43$ 7, $A_4=-0.17$ 7. Pol=+0.56 25.
	2717.4 12	41 3	E2		$\delta(\text{O/Q})=0.00$ 2. $A_2=+0.49$ 7, $A_4=-0.18$ 6. Pol=+0.96 30.
4590.8	404.4 4	24 5			
	647.2 5	49 5	M1 (+E2)	0.00 2	$A_2=-0.30$ 1, $A_4=-0.03$ 2. Pol=-0.47 7.
	1837.4 9	27 5	E1		$\delta(\text{M2/E1})=0.00$ 2.
4621.0	677.4 4	28 4			
	1249.9 7	72 4	M1 (+E2)	-0.02 3	$A_2=-0.26$ 5, $A_4=+0.07$ 6. Pol=-0.47 20.
5155.4	760.4 5	65 3	M1+E2		δ : -0.08 2 or -0.15 2. $A_2=-0.36$ 2, $A_4=-0.05$ 2. Pol=-0.20 10.
	1493.1 6	35 3			δ : 0.00 2 for 17/2 to 13/2, but no $\gamma(\theta)$ data quoted.
5394.6	2640.6 10				
5555.2	964.5 6	<60			
	1611.4 7	>40	M1, E2		δ : 0.00 2 for 19/2+ to 15/2+; +0.7 1 for 15/2+ to 15/2+.
					$A_2=+0.37$ 5, $A_4=-0.19$ 6. Pol=+0.37 25.
5931.5	776.1 5	100	M1 (+E2)		δ : -0.03 2; +0.07 3; -0.11 2 for different $J\pi$ values.
					$A_2=-0.28$ 3, $A_4=-0.01$ 4. Pol=-0.33 18.
6223.4	668.2 5	100	M1 (+E2)		δ : -0.02 3; +0.06 3; +0.09 3 for different $J\pi$ values.
					$A_2=-0.27$ 4, $A_4=-0.05$ 5. Pol=-0.40 17.

[†] From $\gamma(\theta)$ and $\gamma(\text{lin pol})$ (1979Be27).[‡] Quoted by 1979Be27 from 1978En02.[§] I(508 γ)=44 4 and I(1015 γ)=11 2 in 1979Be27 could be mistakenly assigned to each other. Values seem to be from (p,p' γ) (1972Gr04).

Placement of transition in the level scheme is uncertain.

 $^{41}\text{K}(^3\text{He}, \text{p})$ 1968Do02 $J\pi(^{41}\text{K g.s.})=3/2+$.

1968Do02: E=13.0 MeV ^3He beam was produced at the Laboratory for Nuclear Science. Target of enriched ^{41}K (99.18%) on a thin carbon backing, thickness of 78 $\mu\text{g}/\text{cm}^2$. Protons were analyzed with the MIT multiple gap spectrograph. Measured $\sigma(E_p, \theta)$ for transitions up to 9 MeV excitation. A total of 28 groups reported up to 9 MeV excitation. Deduced levels, J, π , L from DWBA analysis.

 ^{43}Ca Levels

E(level)	L	d $\sigma/\text{d}\Omega$ ($\mu\text{b}/\text{sr}$) [†]	Comments
0.0 [‡]		10 [‡]	
990	0	18	Weak population is consistent with configuration= $1f_{7/2}^{-1}4d_{3/2}^{-1}$, J=3/2, T=3/2 as proposed by 1966Do02 in (d,p).
1393?		<4	Very weak population suggests a configuration more complicated than $1f_{7/2}^{-1}4d_{3/2}^{-1}$; J=3/2, T=3/2, proposed by 1966Do02 in (d,p).
2050 [‡]		10 [‡]	
2270 [‡]		15 [‡]	

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$^{41}\text{K}(^3\text{He,p})$ 1968Do02 (continued) **^{43}Ca Levels (continued)**

E(level)	L	$d\sigma/d\Omega$ ($\mu\text{b/sr}$) [†]	Comments
2843	0	46	Strongest transition below 6 MeV. Strong population relative to the 990 group is consistent with configuration= $1f_{7/2}^{-1}1d_{3/2}^{-1}$; $J\pi=3/2^+$, $T=3/2$.
3100 [‡]		15 [‡]	
3300 [‡]		30 [‡]	Similarity to 4984, 9/2+ state in ^{41}Ca indicates 4p-1h component in this level.
3916	2	10 [‡]	
6300 [‡]		40 [‡]	
6410 [‡]		30 [‡]	
6460 [‡]		45 [‡]	
6570 [‡]		30 [‡]	
6640 [‡]		60 [‡]	
6680 [‡]		60 [‡]	
6790 [‡]		100 [‡]	
6950 [‡]		80 [‡]	
7040 [‡]		50 [‡]	
7090 [‡]		80 [‡]	
7190 [‡]		160 [‡]	
7500 [‡]		190 [‡]	
7570 [‡]		80 [‡]	
7730 [‡]		80 [‡]	
7920 [‡]		95 [‡]	
8033 30	0	640 [‡]	T=5/2. IAS of ^{43}K ground state.
8160 [‡]		35 [‡]	
8270 [‡]		45 [‡]	
8470 [‡]		110 [‡]	
8930 [‡]		90 [‡]	

[†] At $\theta=7.5^\circ$.[‡] Approximate value read from a plot (in 1968Do02) of excitation energy versus $d\sigma/d\Omega$. Uncertainty in level energy is estimated at ≈ 30 keV. **$^{41}\text{K}(\alpha,d)$ 1977Na30** $J\pi(^{41}\text{K g.s.})=3/2^+$.

1977Na30 (also 1975Na18): E=40 MeV α beam was produced from the MSU Cyclotron. Enriched ^{41}K target (98%) on a thin carbon foil, thickness of ≈ 100 $\mu\text{g}/\text{cm}^2$. Deuteron particles were analyzed with a split-pole magnetic spectrograph (FWHM=40 keV) and detected by a proportional-counter in the focal plane. Measured $\sigma(E_d, \theta)$ from 6° to 55° . Deduced levels, J, π , L from DWBA analysis. Absolute differential cross sections are accurate to 30%.

For transferred proton-neutron pair, proposed configurations are: $(d_{3/2}p_{3/2})$ for L=3, $[(f_{7/2})^2_5 + (f_{7/2}p_{3/2})_5]$ for L=4, $(d_{3/2}f_{7/2})$ for L=5, $[(f_{7/2})^2_5 + (f_{7/2}p_{3/2})_5 + (f_{7/2})^2_7]$ for L=4+6, and $(f_{7/2})^2_7$ for L=6.

 ^{43}Ca Levels

E(level)	$J\pi^\S$	L	$d\sigma/d\Omega$ ($\mu\text{b/sr}$) [‡]	E(level)	$J\pi^\S$	L	$d\sigma/d\Omega$ ($\mu\text{b/sr}$) [‡]
0.0	$7/2^-$ -#	5	150	4291 10	$(11/2^+, 13/2^+)$	4+6	32, 21
2045 10	$3/2^-$ -#	3	65	4357 10	$(11/2^+, 13/2^+)$	4+6	58, 25
2850 10	$(11/2^+, 13/2^+)$	4+6	23, 20	4462 10	$(11/2^+, 13/2^+)$	4+(6)	33, 6
2951 10		6	76	4591 10		6	510
3072 10	$(11/2^+, 13/2^+)$	4+6	10, 18	4701 10			
3196 [†] 10				4888 10	$(11/2^+ \text{ to } 17/2^+)$	6	105
3278 10	$(11/2^+ \text{ to } 17/2^+)$	6	24	5189 10	$(11/2^+, 13/2^+)$	4+6	20, 35
3372 10		6	79	5246 10	$(11/2^+, 13/2^+)$	4+6	110, 28
3500 10	$(11/2^+, 13/2^+)$	4+6	130, 110	5351 10	$(11/2^+, 13/2^+)$	4+6	78, 34
3838 10	$(7/2^+ \text{ to } 13/2^+)$	4	60	5696 10	$(11/2^+, 13/2^+)$	4+6	42, 37
3944 10		6	135	6087 10			
4134 10	$(11/2^+, 13/2^+)$	6	78	6173 10			
4191 10	$(11/2^+ \text{ to } 17/2^+)$	6	220				

[†] Very weakly populated.

Footnotes continued on next page

$^{41}\text{K}(\alpha, d)$ 1977Na30 (continued) **^{43}Ca Levels (continued)**

‡ At 10°.

§ Above 2045, the assignments are from 1977Na30, based on $L(\alpha, d)$ from 3/2+. For transferred proton-neutron pair, proposed configurations are: $(d_{3/2}p_{3/2})$ for L=3, $[(f_{7/2})^2_{5+}(f_{7/2}p_{3/2})_5]$ for L=4, $(d_{3/2}f_{7/2})$ for L=5, $[(f_{7/2})^2_{5+}(f_{7/2}p_{3/2})_5+(f_{7/2})^2_{7-}]$ for L=4+6, and $(f_{7/2})^2_{7-}$ for L=6.

From Adopted Levels.

 $^{42}\text{Ca}(n, \gamma)$ E=thermal 1969Gr08, 1978Ve061969Gr08: Thermal neutron beam was produced from the Dutch High Flux Reactor, with intensity of $10^7 \text{ cm}^{-2}\text{s}^{-1}$ on enriched ^{42}Ca target. γ -rays were detected by a 6.5 cm^3 planar Ge(Li) detector. Measured $E\gamma$, $I\gamma$, $\gamma\gamma$. Deduced levels, J, γ -branching ratios.1978Ve06: Polarized thermal neutron beam was produced from the HFR at Petten, with intensity of $2 \times 10^7 \text{ cm}^{-2}\text{s}^{-1}$ on enriched ^{42}Ca target. γ -rays were detected with Ge(Li) detectors. Measured $\gamma(\text{circ pol})$. Deduced levels, J.

Others:

1971BiZH: E=thermal. Measured $E\gamma$, $I\gamma$, $\gamma\gamma$.1971Cr02: E=thermal. Measured $E\gamma$, $I\gamma$. Data for three secondary γ -rays.

1989Ra06: E=thermal.

 ^{43}Ca Levels

$E(\text{level})^\dagger$	$J\pi^\dagger$	$T_{1/2}$	Comments
0.0	7/2-		
372.72 17	5/2-		
593.31 23	3/2-@		
990.4 3	3/2+		
1394.5 5	5/2+		
1957.3 8	1/2+		
2046.33 21	3/2-@		
2102.8 5	3/2-		
2272.8 12			
2610.9 4	1/2-@		
2878.2 5	1/2-@		
2943.5 4	3/2-@		
3286.1 6	3/2-@		
3315.4 6	1/2-, 3/2-		
3572.6 4	3/2-@		
4207.3 4	1/2-@		
4602.6 11	(1/2, 3/2, 5/2+)		
4641.5 11	3/2+, 5/2+		
4901.2 6	1/2-, 3/2-@		
5037.8 6	1/2-, 3/2-@		
(7932.7§ 3)	1/2+#	1.1 eV 2	Γ from 2006MuZX.

† From Adopted Levels, unless otherwise stated.

‡ Least-squares fit to $E\gamma$ data.

§ Observed de-excitation intensity is 88% of g.s. feeding.

s-wave capture in ^{42}Ca g.s.@ From (pol n, γ) measurements (1978Ve06). **$\gamma(^{43}\text{Ca})$** Asymmetry ratios from (pol n, γ) are given under comments as R values. $I\gamma$ normalization: normalized assuming $I\gamma(\text{g.s.})=100$. Capture $\sigma_0=0.68 \text{ b}$ (2006MuZX).

$E\gamma^{\dagger\ddagger}$	$E(\text{level})$	$I\gamma^{\dagger\#}$	Comments
220.6 3	593.31	11 1	
372.70 20	372.72	38 4	
396.9 4	990.4	0.9 2	
404.0 8	1394.5	0.5 2	
564.4 6	2610.9	1.5 5	
593.4 6	593.31	23 2	

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$^{42}\text{Ca}(\text{n},\gamma)$ E=thermal 1969Gr08,1978Ve06 (continued) $\gamma(^{43}\text{Ca})$ (continued)

$E\gamma^{\dagger\ddagger}$	E(level)	$I\gamma^{\dagger\#}$	Comments
617.7 3	990.4	6.6 7	
651.6 6	2046.33	0.9 5	
831.4 10	2878.2	0.4 2	
840.9 10	2943.5	0.3 2	
^x 878.2 6		0.9 2	
967.5 15	1957.3	≈ 0.2	
1021.5 10	1394.5	1.4 4	
1055.9 6	2046.33	4.2 6	
1239.1 12	3286.1	1.0 2	
1268.9 6	3315.4	0.7 2	
1363.9 10	1957.3	1.5 10	
^x 1370.5 10		1.1 2	
1453.0 3	2046.33	4.9 5	
1525.4 10	3572.6	0.7 2	
1673.5 4	2046.33	11.9 12	
1729.9 10	2102.8	1.2 4	
2017.8 8	2610.9	2.8 3	
2046.3 3	2046.33	38 4	
2102.7 6	2102.8	1.2 5	
2161.1 6	4207.3	2.1 3	
2285.4 10	2878.2	1.4 3	
2350.3 4	2943.5	2.5 3	
2595.3@	4641.5		
2628.4	4901.2		$I\gamma(2628)/I\gamma(2855)=0.67$ 47 (quoted by 1990En08).
2798.4	4901.2		$I\gamma(2798)/I\gamma(2855)=1.00$ 85 (quoted by 1990En08).
2854.8	4901.2		
2895.1 5	(7932.7)	2.0 3	R=+2.1 9 (1978Ve06).
2978.9 7	3572.6	1.2 3	
2992.4 10	5037.8	0.6 3	
3031.3 10	(7932.7)	1.1 3	R=+0.9 5 (1978Ve06).
3199.4	3572.6	0.3 2	
3291.1	(7932.7)		
3330.0	(7932.7)		
3613.4 8	4207.3	4.7 12	
^x 3654.7 6		0.9 3	
3725.3 3	(7932.7)	8.3 12	R=+0.98 15 (1978Ve06).
4009.8@	4602.6		
4307.6	4901.2		$I\gamma(4308)/I\gamma(2855)=0.67$ 60 (quoted by 1990En08).
4359.5 5	(7932.7)	2.9 4	R=-0.4 2 (1978Ve06).
4616.6 9	(7932.7)	0.6 3	
4646.2 6	(7932.7)	2.4 5	R=-0.3 2 (1978Ve06).
^x 4836.8 9		≈ 0.1	
4989.2 5	(7932.7)	3.6 5	R=-0.55 18 (1978Ve06).
5054.2 5	(7932.7)	2.4 4	R=+0.6 3 (1978Ve06).
5321.4 5	(7932.7)	4.1 6	R=+0.79 19 (1978Ve06).
^x 5420.7 12		≈ 0.2	
5828.6 15	(7932.7)	0.9 3	
5886.0 4	(7932.7)	53§ 8	R=-0.50 3 (1978Ve06).
5975.2 15	(7932.7)	0.6 3	
7339.0 7	(7932.7)	5.7 9	R=-0.50 11 (1978Ve06).

[†] From 1969Gr08. Recoil correction, applied by 1969Gr08, has been removed by the evaluators.

[‡] Gamma energies in 1969Gr08 have been compared with those in the PGAA-LBL Budapest database (2007ChZX).

§ From measured elemental $\sigma_n=0.024$ b 4 (2007ChZX, PGAA database), abundance of $^{42}\text{Ca}=0.647\%$, and $\sigma_0=0.68$ b 7 (2006MuZX), $\sigma_f=0.37$ b 6 and $I\gamma=54$ 10/100 n-captures, which agrees with 53 8 from 1969Gr08.

Absolute intensity per 100 neutron captures.

@ Placement of transition in the level scheme is uncertain.

^x γ ray not placed in level scheme.

⁴²Ca(n,γ),(n,n): Resonances 2006MuZX

2006MuZX: Compilation of thermal neutron induced σ and resonance parameter data for nuclei of Z=1-100.

1977Mu02: E(n)>2.5 keV. Measured parameters for about 60 resonances (24 s-wave and 21 p-wave) between 9.143 keV and 229.6 keV.

1971Ch56: E(n)=10-100 keV. Measured E_γ, resonances.

1966Fa02: E(n)=30-600 keV. Measured resonances Others: 1971Ch56, 1966Go38.

⁴³Ca Levels

$$g\Gamma_n = (2J+1)\Gamma_n/2.$$

All resonance parameters including resonance neutron energies, Jπ, L, gΓ_n and Γ_γ are directly adopted from the compilation in 2006MuZX unless otherwise indicated.

E(level) [†]	Γ _γ	L	E _n (lab) (keV)	Comments
7929.2?	1.06 eV	0	-3.85	
7941.82 17	0.56 eV 10	1	9.143 4	gΓ _n =1.0 eV 5. gΓ _n Γ _γ /Γ=0.36 eV 4. gΓ _n =3 eV 1.
7942.02 17	0.645 eV 80	0	9.345 4	gΓ _n Γ _γ /Γ=0.53 eV 6. gΓ _n Γ _γ /Γ=0.13 eV 1. gΓ _n =20 eV 5.
7951.50 17		1	19.06 1	gΓ _n Γ _γ /Γ=0.42 eV 5.
7955.07 17	0.435 eV 50	0	22.71 1	gΓ _n Γ _γ /Γ=0.022 eV 4. gΓ _n =3 eV.
7956.11 17		1	23.78 1	gΓ _n Γ _γ /Γ=0.56 eV 6. gΓ _n =2 eV.
7958.56 17	0.68 eV 10	0	26.29 1	gΓ _n Γ _γ /Γ=0.53 eV 6. gΓ _n =1000 eV 300.
7968.85 17	0.56 eV 5	1	36.82 1	gΓ _n Γ _γ /Γ=0.33 eV 4. gΓ _n =300 eV.
7969.45 17	1.36 eV 15	0	37.44 1	gΓ _n =15 eV.
7972.04 17		1	40.09 1	gΓ _n Γ _γ /Γ=0.59 eV 6. gΓ _n Γ _γ /Γ=0.15 eV 2.
7977.9		0	46	gΓ _n =10 eV.
7980.00 17	0.61 eV 6	0	48.24 2	gΓ _n Γ _γ /Γ=0.30 eV 3. gΓ _n =5 eV.
7981.42 17		1	49.70 2	gΓ _n Γ _γ /Γ=0.68 eV 7.
7981.59 17	0.31 eV 5	1	49.87 2	gΓ _n =20 eV.
7989.86 17	0.79 eV 8	0	58.34 2	gΓ _n Γ _γ /Γ=0.77 eV 8. gΓ _n =50 eV.
7991.74 17	0.8 eV 1	0	60.26 2	gΓ _n Γ _γ /Γ=0.38 eV 5.
7996.53 17	0.38 eV 5	0	65.17 3	gΓ _n Γ _γ /Γ=0.21 eV 4. gΓ _n Γ _γ /Γ=0.44 eV 5.
8002.06 17		1	70.83 3	gΓ _n =10 eV.
8006.39 17		1	75.27 3	gΓ _n Γ _γ /Γ=1.06 eV 12. gΓ _n =200 eV 50.
8007.56 17	1.19 eV 15	0	76.46 3	gΓ _n Γ _γ /Γ=0.44 eV 5. gΓ _n =10 eV.
8013.58 17	0.44 eV 5	0	82.63 4	gΓ _n Γ _γ /Γ=0.83 eV 10.
8014.19 17	0.5 eV 1	1	83.25 4	gΓ _n Γ _γ /Γ=0.79 eV 10.
8020.10 17			89.31 4	gΓ _n Γ _γ /Γ=0.69 eV 10.
8020.46 17			89.68 4	gΓ _n Γ _γ /Γ=0.51 eV 7.
8023.43 19			92.72 8	gΓ _n Γ _γ /Γ=0.71 eV 8.
8023.71 19			93.00 8	gΓ _n Γ _γ /Γ=0.47 eV 6.
8025.53 19			94.87 8	gΓ _n =5 eV.
8028.49 19	0.98 eV 15	0	97.90 8	gΓ _n Γ _γ /Γ=0.82 eV 10. gΓ _n Γ _γ /Γ=0.40 eV 6.
8033.77 20		1	103.3 1	gΓ _n =20 eV.
8047.14 20	1.60 eV 15	0	117.0 1	gΓ _n Γ _γ /Γ=1.50 eV 15.
8049.19 20	0.41 eV 8	1	119.1 1	gΓ _n =10 eV.
8052.0 10	1.55 eV	0	122 1	gΓ _n Γ _γ /Γ=0.76 eV 12. gΓ _n =3750 eV.
8055.93 20	0.70 eV 8	1	126.0 1	gΓ _n Γ _γ /Γ=1.55 eV.
8057.0 10		0	127 1	gΓ _n =10 eV.
8057.01 20		1	127.1 1	gΓ _n Γ _γ /Γ=1.23 eV 15. gΓ _n =11000 eV. gΓ _n Γ _γ /Γ=1.5.

Continued on next page (footnotes at end of table)

$^{42}\text{Ca}(\text{n},\gamma),(\text{n},\text{n}): \text{Resonances}$ 2006MuZX (continued) **^{43}Ca Levels (continued)**

$E(\text{level})^\dagger$	Γ_γ	L	$E_n(\text{lab})$ (keV)	Comments
8057.40 20			127.5 1	$g\Gamma_n\Gamma_\gamma/\Gamma=0.72$ eV 10.
8058.28 20			128.4 1	$g\Gamma_n\Gamma_\gamma/\Gamma=1.26$ eV 15.
8061.0 3	0.56 eV 8	1	131.2 2	$g\Gamma_n=5$ eV.
				$g\Gamma_n\Gamma_\gamma/\Gamma=0.50$ eV 8.
8062.1 3		0	132.4 2	$g\Gamma_n\Gamma_\gamma/\Gamma=0.87$ eV 10.
8066.0 3	0.41 eV 8	1	136.3 2	$g\Gamma_n=5$ eV.
				$g\Gamma_n\Gamma_\gamma/\Gamma=0.38$ eV 6.
8073.8 3	0.94 eV 15	0	144.3 2	$g\Gamma_n=75$ eV.
				$g\Gamma_n\Gamma_\gamma/\Gamma=0.93$ eV 13.
8074.5 3	0.47 eV 8	1	145.1 2	$g\Gamma_n=20$ eV.
				$g\Gamma_n\Gamma_\gamma/\Gamma=0.89$ eV 13.
8075.4 3			146.0 2	$g\Gamma_n\Gamma_\gamma/\Gamma=0.67$ eV 9.
8078.3 3		0	148.9 2	$g\Gamma_n\Gamma_\gamma/\Gamma=1.44$ eV 17.
8081.0 3			151.6 3	$g\Gamma_n\Gamma_\gamma/\Gamma=0.90$ eV 12.
8086.0 3	1.63 eV 18	0	156.8 3	$g\Gamma_n=300$ eV 50.
				$g\Gamma_n\Gamma_\gamma/\Gamma=1.62$ eV 18.
8089.3 3			160.2 3	$g\Gamma_n\Gamma_\gamma/\Gamma=1.20$ eV 14.
8090.2 4			161.1 4	$g\Gamma_n\Gamma_\gamma/\Gamma=1.53$ eV 18.
8099.2 4			170.4 4	$g\Gamma_n\Gamma_\gamma/\Gamma=1.15$ eV 14.
8103.2 10	1.9 eV 2	0	174.4 10	$g\Gamma_n=2500$ eV 500.
				$g\Gamma_n\Gamma_\gamma/\Gamma=1.9$ eV 2.
8106.0 4	1.70 eV 18	0	177.3 4	$g\Gamma_n=200$ eV.
				$g\Gamma_n\Gamma_\gamma/\Gamma=1.69$ eV 18.
8113.6 4			185.1 4	$g\Gamma_n\Gamma_\gamma/\Gamma=0.78$ eV 11.
8115.3 4	0.56 eV 10	0	186.8 4	$g\Gamma_n=300$ eV.
				$g\Gamma_n\Gamma_\gamma/\Gamma=0.56$ eV 10.
8128.2 5	1.02 eV 14		200.0 5	$g\Gamma_n=300$ eV.
				$g\Gamma_n\Gamma_\gamma/\Gamma=1.02$ eV 14.
8132.8 5			204.8 5	$g\Gamma_n\Gamma_\gamma/\Gamma=1.25$ eV 15.
8134.0 5			206.0 5	$g\Gamma_n\Gamma_\gamma/\Gamma=0.87$ eV 11.
8138.1 5			210.2 5	$g\Gamma_n\Gamma_\gamma/\Gamma=0.40$ eV 6.
8139.8 5	1.30 eV 18	0	211.9 5	$g\Gamma_n=1750$ eV.
				$g\Gamma_n\Gamma_\gamma/\Gamma=1.33$ eV 18.
8141.5 5	0.49 eV 10	1	213.7 5	$g\Gamma_n=20$ eV.
				$g\Gamma_n\Gamma_\gamma/\Gamma=0.94$ eV 15.
8144.2 5			216.4 5	$g\Gamma_n\Gamma_\gamma/\Gamma=0.63$ eV 10.
8149.0 5	0.33 eV 5	1	221.2 5	$g\Gamma_n=260$ eV.
				$g\Gamma_n\Gamma_\gamma/\Gamma=0.67$ eV 10.
8152.2 5	0.325 eV 60	1	224.6 5	$g\Gamma_n\Gamma_\gamma/\Gamma=0.31$ eV 6.
8157.1 5	1.08 eV 18	0	229.6 5	$g\Gamma_n=50$ eV.
				$g\Gamma_n\Gamma_\gamma/\Gamma=1.06$ eV 18.
8165.8		>1	238.5	$g\Gamma_n=500$ eV.
8176.0		>1	249	
8181.0		1	254	$g\Gamma_n=800$ eV.
8186.3		0	259.5	$g\Gamma_n=750$ eV.
8201.0		0	274.5	$g\Gamma_n=750$ eV.
8201.4		>1	275	
8204.8		0	278.5	$g\Gamma_n=1500$ eV.
8206.8		1	280.5	$g\Gamma_n=750$ eV.
8223.0		>1	297	$g\Gamma_n=238$ eV.
8259.0		>1	334	$g\Gamma_n=460$ eV.
8263.0		>1	338	$g\Gamma_n=550$ eV.
8281.0		0	356.5	$g\Gamma_n=1500$ eV.
8302.5		>1	378.5	$g\Gamma_n=295$ eV.
8308.8		>1	385	
8323.0		0	399.5	$g\Gamma_n=500$ eV.
8341.0		0	418	$g\Gamma_n=400$ eV.
8348.0		0	425	$g\Gamma_n=300$ eV.
8367.4		>1	445	
8369.4		>1	447	$g\Gamma_n=1000$ eV.
8372.8		0	450.5	$g\Gamma_n=1750$ eV.
8399.6		0	478	$g\Gamma_n=750$ eV.
8412.8		0	491.5	$g\Gamma_n=1000$ eV.

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⁴²Ca(n,γ),(n,n): Resonances 2006MuZX (continued)

⁴³Ca Levels (continued)

E(level) [†]	L	E _n (lab) (keV)	Comments
8418.7	>1	497.5	
8430.0	>1	509	
8434.3	0	513.5	gΓ _n =5500 eV.
8452.4	0	532	gΓ _n =6500 eV.
8465.5	0	545.5	gΓ _n =2000 eV.
8474.8	0	555	gΓ _n =300 eV.
8479.7	0	560	gΓ _n =500 eV.
8484.1	>1	564.5	
8490.0	0	570.5	gΓ _n =10000 eV.
8492.0	>1	572.5	

[†] From E_{c.m.}+S(n) where S(n)=7932.89 17 (2012Wa38) and E_{c.m.} deduced from E_n(lab) in 2006MuZX.

⁴²Ca(d,p) 1966Do02,1974Br19,1977Sc05

Target ⁴²Ca Jπ=0+.

1966Do02: E=7.0, 7.1, 7.2 MeV deuteron beam was produced from the MIT-ONR electrostatic generator. Targets of 93.7% enriched CaCO₃ on carbon and Formvar foils. Protons were analyzed by a multiple-gap spectrograph (FWHM=12 keV) and detected by nuclear emulsions. Measured σ(θ) from 10° to 180°. A total of 83 groups reported. Deduced levels, L, spectroscopic factors from DWBA analysis.

1974Br19 (also 1971Br14): E=7, 8, 10, 12 MeV deuteron beam was produced at AWRE, Aldermaston. Target of 93.7% enriched CaCO₃ on a carbon backing. Protons were analyzed by a multi-gap spectrograph (FWHM=12 keV). Measured σ(θ). Deduced levels, L, spectroscopic factors from DWBA analysis.

1977Sc05: E=2.5 MeV. FWHM=20-25 keV. Measured E(p), σ(θ), deduced ex, L and (2J+1)s for 20 levels up to 5028 keV. DWBA code DWUCK results are given here. Results using code LOLA differ considerably for weakly-populated levels.

Others:

1991NaZZ: E=25 MeV. σ(θ), deduced L-transfers and S- factors for a large number of states up to 9 MeV excitation.

Plots of excitation energy and (2J+1)S values are provided for 1d, 2s, 1f, 2p, 1g, 2d and 3s orbitals. No numerical (tabulated) data are available from this work.

1982En06: E=2, 3, 4, 4.5 MeV. Measured σ(θ) for 0, 373 and 593 levels.

1970Br27: E=10, 12 MeV. Measured σ(θ). Deduced L and (2J+1)s for 0, 2040, 2610 and 2940 states.

1968Be36: E=7.0, 7.2 MeV. Measured σ(θ); data for four states at 0, 990, 1899 and 2041 compared with other Ca isotopes.

1968An10: E=9.99 MeV. Measured σ(θ=35). Comparison of 7/2- g.s. and 3/2- state strengths amongst Ca isotopes.

1968De04, 1968De09: E=8, 10 MeV. Measured σ(θ). Studied J-dependence for g.s. and 990 transitions in ⁴³Ca and other f-shell nuclides.

1965Be23: E=7.0,7.2 MeV. σ(θ) for g.s. and 374 level.

1957Br19: E=5.0, 6.5, 7.4 MeV. θ=90, 130. A total of 26 proton groups reported up to 3420 keV excitation.

1957Bo99 (also 1957Bp01): E=7 MeV. Measured σ(θ), deduced L, strengths relative to ⁴¹Ca g.s. 35 groups reported up to 3584 keV excitation. L-transfers measured for 10 states.

Other: 1964Le02.

Cross section data at 10 MeV (1974Br19)

Level	dσ/dΩ (mb/sr) (max)	Level	dσ/dΩ (mb/sr) (max)
0	2.85	3737	0.04 a
373	0.06	3772	0.11
593	1.36	3810	0.08
990	0.29	3864	0.35
1393	0.03	3898	0.02 a
1676	0.03	3916	0.48
1899	0.05	3958	0.07 a
1928	0.02	3978	0.10
1954	2.79	4017	0.09
2041	28.2	4048	0.10
2096	0.04	4089	0.07
2219	0.02	4124	0.06
2246	0.06	4148	0.28
2269	0.06	4196	10.3
2523	0.11	4239	1.41

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$^{42}\text{Ca}(\text{d},\text{p})$ 1966Do02,1974Br19,1977Sc05 (continued)

2607	2.90	4268	0.26
2669	0.06	4298	0.32
2693	0.11	4401	0.3 a
2758	0.15	4460	0.18
2843	0.11	4498	0.15
2874	2.05	4533	0.21
2939	2.10	4638	0.41
3022	0.02	4654	0.21
3045	0.03	4705	0.14
3071	0.30	4897	2.25
3091	0.1 a	4982	0.52
3287	1.34	5008	0.19
3314	0.37	5028	2.59
3352	0.03 a	5047	0.87
3376	0.02 a	5072	0.69
3417	0.16	5100	0.27
3566	2.30	5170	0.29
3604	0.06	5193	0.58
3655	0.05	5215	1.46
3705	0.02 a		

Uncertainties in cross sections=10%.

a: Estimated from plots given by 1966Do02.

 ^{43}Ca Levels

E(level) [†]	L [‡]	(2J+1)S [‡]	E(level) [†]	L [‡]	(2J+1)S [‡]	E(level) [†]	L [‡]	(2J+1)S [‡]
0.0	3	4.5	3314 10	1	0.03	4401 10		
373# 10	3	3.9	3352 10			4429§ 10		
593# 10	1	0.16	3376 10			4460 10	3 ^a	0.36 ^a
990 10	2&	0.28&	3417 10	3	0.19	4498 10		
1393 10	(2)	0.03	3566 10	1	0.19	4533 10	0	0.002
1676 10			3604 10	0	0.001	4585 10		
1899 10			3655 10	(2)	0.01	4609 10		
1928 10			3705 10			4638 10	2	0.06
1954 10	0	0.10	3737 10			4654@ 10	0	0.002
2041 10	1	2.9	3772 10	1	0.01	4705 10		
2096 10	1	0.04	3783 10			4736 10		
2219 10			3810 10	(3) ^a	0.16 ^a	4758 10		
2246 10			3864 10	(1) ^d	0.05	4783 10		
2269 10	(2)	0.01	3898 10			4796 10		
2404 10			3916 10	(1,4) ^b	0.04 ^b	4826 10		
2523 10	(1)	0.01	3958 10			4854 10		
2607 10	1	0.28	3978 10	2	0.01	4874 10		
2669 10	3	0.08	4017 10			4897 10	1	0.14
2693 10	2	0.02	4048 10	2	0.01	4922 10		
2758 10	0	0.002	4078 10			4944 10		
2843 10	0	0.001	4089 10	(3)	0.08	4982 10	2 ^e	0.07 ^e
2874 10	1	0.18	4124 10	4	0.19	5008 10		
2939 10	1	0.19	4148 10	0	0.003	5028 10	1	0.16
3022 10			4196 10	1	0.86	5047	1	0.06
3045 10			4239 10	1	0.10	5072	1	0.04
3071 10	0	0.003	4268 10	1 ^c	0.04	5100	0	0.003
3091 10			4298 10	0	0.003	5170	2	0.04
3191 10			4324§ 10			5193	0	0.006
3287 10	1	0.12	4370 10			5215	0	0.015

[†] From 1966Do02 up to 5028 keV and from 1974Br19 above this energy.[‡] From 1974Br19, unless otherwise stated.

§ The existence of this level is considered unlikely by 1978En02.

Principally populated via two-step processes (1982En06).

@ From 1974Br19.

& From 1968Be36.

^a From 1966Do02.^b L=4, S=1.19 (1966Do02); but L=(1) in 1974Br19.^c L=1 in 1974Br19 but 2 in 1966Do02.

Footnotes continued on next page

$^{42}\text{Ca}(\text{d,p})$ 1966Do02,1974Br19,1977Sc05 (continued)

 ^{43}Ca Levels (continued)

d 1 (1966Do02).

e L=1, S=0.05 (1966Do02). L=2 in 1974Br19.

 $^{42}\text{Ca}(\alpha,^3\text{He})$ 1982Ho17

Target ^{42}Ca $J\pi=0+$.

1982Ho17: E=36 MeV α beam was produced from the Orsay MP tandem. Target of 95% enriched ^{42}Ca backed by a 10 $\mu\text{g}/\text{cm}^2$ carbon film, thickness of 160 $\mu\text{g}/\text{cm}^2$. ^3He particles were analyzed by a split-pole magnetic spectrograph and detected by six position sensitive silicon detectors in the focal plane, FWHM=20 keV. Measured $\sigma(E(^3\text{He}),\theta)$ from 4° to 42° . Uncertainty in cross sections $\approx 15\%$. Deduced levels, L, spectroscopic factors from DWBA and coupled-reaction-channel (CRC) analysis.

Cross section values			
Level energy	$d\sigma/d\Omega$ (mb/sr)	Level energy	$d\sigma/d\Omega$ (mb/sr)
0	7.0	3645	0.019
373	0.105	3803	0.030
593	0.011	3913	0.062
990	0.180	4041	0.029
1395	0.013	4123	0.017
1678	0.014	4193	0.004
1957	0.023	4463	0.094
2046	0.093	4569	
2249	0.023	4826	0.037
2611	0.007	4880	0.022
2674	0.068	5001	0.052
2741	0.008	5040	0.018
2850	0.019	5200	0.120
2948	0.016	5251	0.018
3044	0.023	5410	0.006
3085	0.031	5548	0.035
3193	0.067	5647	0.012
3278	0.080	5727	0.025
3371	0.018	5805	0.022
3413	0.065	5889	0.027
3504	0.025	5991	0.049

 ^{43}Ca Levels

E(level)	L	$(2J+1)S^\dagger$	Comments
0.0	3	5.40	
373 8	3	0.15	
593 8	1	0.17	
990 $\frac{5}{2}$ 8	2	0.87	$\sigma(\text{exp})/\sigma(\text{theory-CRC})=8.5$.
1395 8	2	0.06	
1678 $\frac{5}{2}$ 8			$\sigma(\text{exp})/\sigma(\text{theory-CRC})=0.04$.
1957 $\frac{5}{2}$ 8	(0)		$\sigma(\text{exp})/\sigma(\text{theory-CRC})=3$.
2046 8	1	4.26	
2249 $\frac{5}{2}$ 8			$\sigma(\text{exp})/\sigma(\text{theory-CRC})=0.70$.
2611 8	1	0.33	
2674 8	3	0.28, 0.18	
2741 $\frac{5}{2}$ 8			$\sigma(\text{exp})/\sigma(\text{theory-CRC})=1$.
2850 $\frac{5}{2}$ 8	2	0.32, 0.27	$\sigma(\text{exp})/\sigma(\text{theory-CRC})=2.1$.
2948 $\frac{3}{2}$ 8	(1)	0.74	11/2+ component considered in CRC calculations. $\sigma(\text{exp})/\sigma(\text{theory-CRC})=0.5$ (for 11/2+ component). $\sigma(\text{exp})/\sigma(\text{theory-CRC})=0.06$.
3044 $\frac{5}{2}$ 8			
3085 8	2	0.70, 0.55	
3193 8	4	0.10	
3278 $\frac{3}{2}$ 8	(4)	0.13	
3371 $\frac{5}{2}$ 8			$\sigma(\text{exp})/\sigma(\text{theory-CRC})=0.11$.
3413 8	3	0.43, 0.29	
3504 $\frac{5}{2}$ 8			$\sigma(\text{exp})/\sigma(\text{theory-CRC})=0.13$.

Continued on next page (footnotes at end of table)

$^{42}\text{Ca}(\alpha, ^3\text{He})$ 1982Ho17 (continued) **^{43}Ca Levels (continued)**

E(level)	L	(2J+1)S [†]	Comments
3645 § 8			$\sigma(\text{exp})/\sigma(\text{theory-CRC})=3.$
3803 8	(3)	0.20	
3913 ‡ 8	(4)	0.14	
4041 8			
4123 8	(4)	0.04	
4193 8	1	0.44	
4463 8	(3)	1.45	
4569 8			
4826 8	(3)	0.90	
4880 8			
5001 8	(3)	1.16	
5040 8			
5200 8	(3)	2.80	
5251 § 8			$\sigma(\text{exp})/\sigma(\text{theory-CRC})=3.2.$
5410 8			
5548 ‡ 8			
5647 ‡ 8			
5727 ‡ 8			
5805 8			
5889 ‡ 8			
5991 8	(3)	2.75	

[†] Normalization factor N=46 used in the DWBA formula relating experimental and DW cross sections. When two values are quoted, these correspond to J=L-1/2 and J=L+1/2, respectively.

[‡] Doublet.

§ Considered in coupled-reaction-channel (CRC) analysis. Multiplets considered are: f7/2 neutron coupled to 2+ at 1520, 4+ at 2750 and 3- at 3440 in ^{42}Ca .

 $^{43}\text{Ca}(\text{p}, \text{p}')$ 1957Br19

1957Br19: E=6.5, 7.0 MeV proton beam was produced from the MIT-ONR electrostatic generator. Target of enriched CaCO_3 (67.95% ^{43}Ca). Scattered protons were analyzed with a broad-range spectrograph. Measured $\sigma(E_p)$. Deduced levels.

1980Fa07: (p,p) E=35.2 MeV proton beam was produced from the Milan sector-focused cyclotron. Target of CaCO_3 enriched to 49.1% in ^{43}Ca . Scattered protons were detected by silicon surface-barrier detectors in rotatable counter telescopes. Measured $\sigma(E_p, \theta)$. Deduced deformation parameter.

All data are from 1957Br19 unless otherwise noted.

 ^{43}Ca Levels

E(level) [†]	E(level) [†]	E(level) [†]
0.0 §	2105?	3026
371	2223	3047
591	2248 ‡	3073
990	2271? ‡	3093
1394	2407	3193
1677	2604?	3278
1903	2671	3292 ‡
1931	2694	3368? ‡
1956	2751	3397? ‡
2046	2842	3418
2067	2878?	
2093	2946	

[†] Uncertainty is probably 5–10 keV (by evaluators).

[‡] Unresolved from impurities peaks from ^{40}Ca or ^{44}Ca .

§ $\beta_2(\text{electromagnetic})=0.25$ (1980Fa07).

⁴³Ca(p,p'γ) 1972Gr04

1972Gr04: E=4.235 MeV proton beam was produced from the Groningen 5 MV Van de Graaff accelerator. Target consisted of a layer of 87 μg/cm² ⁹CaO evaporated onto a 185 μg/cm² carbon foil, 81% in ⁴³Ca. γ-rays were detected by a 30 cm³ true-coaxial Ge(Li) detector. Measured Eγ, Iγ, pγ coin. Deduced levels, J, π, γ-branching, T_{1/2} by DSAM.

Other:

1968Ch12: 2.550, 3.235, 3.605 MeV. Measured γ, γγ, excitation functions.

1967Fo01: Measured T_{1/2} of the 593 keV level p'γ-coin..

1985Ki07: Measured thick target relative γ-yields.

⁴³Ca Levels

E(level) [†]	Jπ [‡]	T _{1/2} [§]	E(level) [†]	Jπ [‡]	T _{1/2} [§]
0.0	7/2-		2067.10 17	7/2-	21 fs 7
372.76 7	5/2-	>3.5 ps	2093.85 20	9/2-	1.2 ps 4
593.38 8	3/2-	160 ps # 10	2224.1 4	3/2-, 5/2-	>49 fs
990.27 9	3/2+	>4.9 ps	2248.95 14	9/2-	40 fs 8
1394.55 9	5/2+	1.73 ps 35	2272.4 5	3/2+, 5/2+	>0.35 ps
1677.89 19	11/2-	0.83 ps 14	2409.74 18	9/2+	1.2 ps +6-4
1901.99 16	7/2+	0.55 ps 10	2673.5 3	5/2-, 7/2-	31 fs 13
1931.48 15	5/2-	0.11 ps 3	2695.7 15	3/2+, 5/2+	<70 fs
2045.9 6	3/2-	>0.49 ps			

[†] From least-squares fit to Eγ data.

[‡] From Adopted Levels.

[§] From DSAM (1972Gr04).

From p'γ(t) (1967Fo01).

γ(⁴³Ca)

Measured limits of Iγ values of γ-rays (involving ΔJ>2 or ΔJ=2, Δπ=yes) from different levels are as follows:

990 level: Iγ<1.5 to g.s.

1678 level: Iγ<2 to 373 level, Iγ<1 to 593 level, Iγ<0.5 to 990 and 1395 levels

1901 level: Iγ<4 to 1678 level, Iγ<3 to 593 level

1931 level: Iγ<7 to 1678 level

2067 level: Iγ<5 to 990 level

2093 level: Iγ<1 to 1395 level, Iγ<2 to 990 level, Iγ<4 to 593 level

2249 level: Iγ<1.3 to 1395 level, Iγ<2.5 to 990 and 593 levels

2409 level: Iγ<6.7 to 990 level, Iγ<4.4 to 593 level, Iγ<9 to 373 level

E(level)	Eγ [†]	Iγ	E(level)	Eγ [†]	Iγ	E(level)	Eγ [†]	Iγ
372.76	372.83 10	100	1931.48	537 [§]	<8.6	2224.1	1632 2	60 8
593.38	220.66 10	33 2		941 [§]	<19		1851.3 4	40 8
	593.36 10	67 2		1339.5 [‡] 16	9 4	2248.95	347 [§]	<1.3
990.27	396.9 2	13 2		1558.7 2	33 5		570.7 [‡] 5	2.0 5
	617.51 7	87 2		1931.4 2	58 5		1876.2 2	18 5
1394.55	404.3 2	13 1	2045.9	2045.8 6	100		2248.9 2	80 5
	801.1 16	6 1		389 [§]	<2.5	2272.4	877.8 [‡] 5	100
	1021.80 7	77 2	2067.10	672 [§]	<2.5	2409.74	508.0 [‡] 10	11 2
	1394.5 2	3.7 6		1474 [§]	<6.3		732 [§]	<6.7
1677.89	1677.8 2	100		1694.2 3	20 2		1015.2 2	44 4
1901.99	507.8 [‡] 3	17 2		2067.1 2	80 2		2409.6 3	45 4
	911.7 5	13 4	2093.85	416 [§]	<1	2673.5	1276.0 [§] 10	20
	1529 [§]	<3		1721 [§]	<5		2300.7 3	100
	1901.8 2	70 4		2093.8 2	100	2695.7	2322.9 [‡] 15	100

[†] Recoil correction applied by 1972Gr04 is removed (evaluators).

[‡] From coin spectra.

[§] Placement of transition in the level scheme is uncertain.

$^{43}\text{Ca}(\text{d},\text{d}') \quad ^{1965}\text{Be11}$

Target ^{43}Ca $J\pi=7/2^-$.

$^{1965}\text{Be11}$: $E=8.522$ MeV deuteron beam was produced from the tandem electrostatic generator of the Atomic Weapons Research Establishment (AWRE), Aldermaston, England. Target of enriched ^{43}Ca (>99.9%). Deuteron spectra recorded with a multi-gap magnetic spectrometer, FWHM=15 keV. Measured $\sigma(\theta)$. Deduced levels, J , π , L , deformation parameters from DWBA analysis.

 ^{43}Ca Levels

E(level)	L	β_2
0.0		
369 5	2	0.114
595 5	2	0.087
1675 5	2	0.13
1932 5	(2)	0.06
2051 5	(2)	0.08
2070 5	4	
2098 5	2	0.09
2252 5	2	0.114

 $^{43}\text{Ca}(\alpha,\alpha') \quad ^{1974}\text{De42}$

$^{1974}\text{De42}$: $E=24.0, 28.5, 31.0$ MeV of 250–400 nA α beam was produced from the University of Rochester MP tandem Van de Graaff accelerator. Target of a isotopically separated metallic calcium evaporated onto a $20 \mu\text{g}/\text{cm}^2$ carbon backing. Scattered α particles were analyzed with an Enge split-pole magnetic spectrograph and detected in the focal plane by a 30 cm long position sensitive proportional detector or 5cm silicon detectors or K-1, 50 μm photographic emulsions. Measured $\sigma(E_\alpha, \theta)$. Deduced levels, J , π , L , transition probabilities from analysis with DWBA and coupled-channel calculations.

 ^{43}Ca Levels

E(level)	$J\pi^\dagger$	L	$\text{BE}(L)^\ddagger$ (isoscalar) ‡	Comments
0.0	7/2-			
373 5	5/2-	2+4	0.0055	L: 76%(L=2), 24%(L=4). $\text{B}(E4)^\ddagger=0.00011$.
593 5	3/2-	2+4	0.0027	L: 73%(L=2), 27%(L=4). $\text{B}(E4)^\ddagger=0.000068$.
1676 5	11/2-	2+4	0.0068	L: 80%(L=2), 20%(L=4). $\text{B}(E4)^\ddagger=0.000053$.
1930 5	5/2-	2+4	0.0020	L: 86%(L=2), 14%(L=4). $\text{B}(E4)^\ddagger=0.000015$.
2045 5	3/2-	2+4	0.0015	L: 62%(L=2), 38%(L=4). $\text{B}(E4)^\ddagger=0.000051$.
2066 5	7/2-	2+4	0.00073	L: 58%(L=2), 42%(L=4). $\text{B}(E4)^\ddagger=0.000032$.
2094 5	9/2-	2+4	0.0026	L: 70%(L=2), 30%(L=4). $\text{B}(E4)^\ddagger=0.000060$.
2248 5	9/2-	2+4	0.0068	L: 83%(L=2), 17%(L=4). $\text{B}(E4)^\ddagger=0.000057$.
2668 5		2+4	0.0011	L: 75%(L=2), 25%(L=4). $\text{B}(E4)^\ddagger=0.000014$.
2694 5		2+4	0.00075	L: 65%(L=2), 35%(L=4). $\text{B}(E4)^\ddagger=0.000021$.
2756 5		(4+6)		L: 57%(L=4), 43%(L=6). $\text{B}(E4)^\ddagger=0.000073$. $\text{B}(E6)=0.0000032$.
2850 5		3+5	0.00019	L: 73%(L=3), 27%(L=5). $\text{B}(E5)^\ddagger=0.0000056$.
2948 5	11/2+	3+5	0.00063	L: 80%(L=3), 20%(L=5). $\text{B}(E5)^\ddagger=0.0000097$.
3025 5				
3048 5	11/2-	2+4	0.0048	L: 83%(L=2), 17%(L=4). $\text{B}(E4)^\ddagger=0.000038$.

Continued on next page (footnotes at end of table)

$^{43}\text{Ca}(\alpha, \alpha')$ 1974De42 (continued) **^{43}Ca Levels (continued)**

E(level)	$J\pi^\dagger$	L	BE(L) $\uparrow$ (isoscalar) ‡	Comments
3091 5		3+5	0.00068	L: 77%(L=3), 23%(L=5). B(E5) $\uparrow$ =0.000013.
3194 5	7/2+, 9/2+	3+5	0.000615	L: 78%(L=3), 22%(L=5). B(E5) $\uparrow$ =0.000011.
3277 10	(11/2 to 17/2)+	3+5	0.00177	L: 74%(L=3), 26%(L=5) for 3277+3297. B(E5) $\uparrow$ =0.000040.
3297 10		3+5	0.00177	L, BE(L) $\uparrow$ (isoscalar): for 3277+3297. B(E5) $\uparrow$ =0.000040.
3377 5	13/2+	3+5	0.00116	L: 72%(L=3), 28%(L=5). B(E5) $\uparrow$ =0.000026.
3469 5				
3502 5	13/2+	3+5	0.00129	L: 79%(L=3), 21%(L=5). B(E5) $\uparrow$ =0.000019.
3660 5	13/2-	(2+4)	0.00092	L: 31%(L=2), 69%(L=4). B(E4) $\uparrow$ =0.00017.
3836 10				
3929 10		3+5	0.00191	L: 68%(L=3), 32%(L=5) for 3929+3942. L, BE(L) $\uparrow$ (isoscalar): for 3929+3942. B(E5) $\uparrow$ =0.00011.
3942 10	15/2+	3+5	0.00191	L, BE(L) $\uparrow$ (isoscalar): for 3929+3942. B(E5) $\uparrow$ =0.00011.
4140 15	7/2+, 9/2+	3+5	0.00062	L: 61%(L=3), 39%(L=5). B(E5) $\uparrow$ =0.000029.

 † From Adopted Levels. ‡ BE(L) $\uparrow$ (isoscalar) for L=2 in case of L=2+4, and for L=3 for L=3+5 transitions. BE(L) $\uparrow$ for L=4 and L=5 are given under comments. Statistical uncertainties are $\approx 15\%$.**Coulomb Excitation 1971HoYN**

1971HoYN: ($^{32}\text{S}, ^{32}\text{S}'\gamma$) E=45 MeV. Thick calcium fluoride (enriched in ^{43}Ca) target. Measured γ -ray yields, deduced B(E2) values for 373 and 1678 levels, normalized to measured B(E2) for 5/2+, 197 level to 1/2+, g.s. in ^{19}F .

 ^{43}Ca Levels

E(level) ‡	$J\pi^\dagger$	Comments
0.0	7/2-	
373	5/2-	B(E2) $\uparrow$ =0.0065 5.
593	3/2-	
1678	11/2-	B(E2) $\uparrow$ =0.0115 28.

 † From Adopted Levels. ‡ Rounded values from Adopted Levels. **$\gamma(^{43}\text{Ca})$**

$E\gamma^\dagger$	E(level)	Mult.	δ	Comments
221	593			
373	373	(M1+E2)	0.161 14	δ : from B(E2)=0.0086 7 (1971HoYN) and $T_{1/2}(373)=34$ ps 3.
593	593			B(E2)=0.0071 3 (1971HoYN), deduced from known lifetime of 593 level and measured (but not quoted) branching ratio.
1678	1678			B(E2)=0.0077 19 (1971HoYN).

 † Rounded values from Adopted Gammas.

⁴⁴Ca(p,d) 1972Ma23,1968Sm05

Target ⁴⁴Ca J π =0+.

1972Ma23 (also 1972MaXL): E=40 MeV proton beam was produced from the the Grenoble variable-energy cyclotron. Targets of natural and enriched ⁴⁴Ca metal foils. Deuterons were detected with ΔE -E counter telescope, FWHM=120 keV.

Measured $\sigma(E_d, \theta)$ from 10° to 60° in 4° steps. Overall accuracy on absolute cross sections $\approx$ 10%. Deduced levels, J, π , L, spectroscopic factors from DWBA analysis.

1968Sm05: E=26.5 MeV proton beam was produced from the University of Colorado Cyclotron. Target of 98.61% enriched ⁴⁴Ca. Deuterons were detected with ΔE -E (silicon surface barrier, 211 μ m and 1090 μ m) counter telescope, FWHM=110 keV. Measured $\sigma(\theta)$ from 21° to 76° in 5° steps. Overall accuracy on absolute cross sections $\approx$ 25%. Deduced levels, J, π , L spectroscopic factors from DWBA analysis.

1966Co06: E=17.5 MeV proton beam was produced from the Princeton FM cyclotron. Target of 98.6% enriched ⁴⁴Ca. Deuterons were detected with ΔE -E (solid-state detector) counter telescope, FWHM=80-100 keV. Measured $\sigma(\theta)$ from 20° to 160° in 10° steps. Overall accuracy on absolute cross sections $\approx$ 25%. Deduced levels, J, π , L spectroscopic factors from DWBA analysis. Levels up to 2050 reported.

Cross section data (1968Sm05)		
Level	energy	d σ /d Ω (mb/sr) (max)
0		6.26
373		0.224
594		0.545
992		3.23
1395		0.141
1680		0.074
1959		2.20
2050		0.531
2252		0.234
2690		0.258
2870		0.266
3050		0.523
3280		0.255
3600		0.045
3920		0.218
4200		0.266
4460		0.308
7970		0.179

⁴³Ca Levels

Spectroscopic factor: $N^*C^2S = \sigma(\theta)^{\text{exp}}/\sigma(\theta)^{\text{DWBA}}$, where $N=2.25$ (1968Sm05) is the normalization factor.

E(level) [†]	J $\pi^{\ddagger}$	L §	C ² S [#]	Comments
0.0	7/2-	3	2.8	C ² S: 3.7 (1968Sm05), 2.4 (1966Co06).
374 25	5/2-	3	0.05	C ² S: 0.15 (1968Sm05).
594 25	3/2-	1	0.04	C ² S: 0.10 (1968Sm05), 0.06 (1966Co06).
993 25	3/2+	2	2.4	C ² S: 2.5 (1968Sm05), 0.8 (1966Co06).
1389 25	(3/2)+	2	0.34	C ² S: 0.16 for 3/2, 0.12 for 5/2 (1968Sm05).
1680 25				
1960 25	1/2+	0	1.0	C ² S: 0.62 (1968Sm05).
2050 25	3/2-	1	0.05	C ² S: 0.18 (1968Sm05).
2250 20	(5/2)+	2	0.26	C ² S: 0.20 for 5/2, 0.28 for 3/2 (1968Sm05).
2660 20	(5/2)+	2	0.26	C ² S: 0.26 for 5/2, 0.36 for 3/2 (1968Sm05).
2840 20	(5/2)+	2	0.34	C ² S: 0.22 for 5/2, 0.37 for 3/2 (1968Sm05).
3050 20	(5/2)+ and 1/2+	2+0	0.47, 0.13	L: from 1972Ma23. Other: L=0, S=0.22 (1968Sm05).
3260 20		(2,3)		L: from 1972Ma23. Other: L=3, S=0.28 for 7/2- in 1968Sm05.
3620 20	(5/2)+	2	0.05	L: from 1972Ma23. Other: L=(1), S=0.02 in 1968Sm05.
3950 20	(5/2)+	2	0.26	C ² S: 0.28 for 5/2, 0.40 for 3/2 (1968Sm05).
4210 20		(2,3)		L: from 1972Ma23. Other: L=(2), S=0.75 for 3/2, 0.53 for 5/2 (1968Sm05).
4460? 20				This group is assigned to ³⁹ Ca g.s. in 1972Ma23. 1968Sm05 assign this group as L=2, S=0.53 for 3/2, 0.37 for 5/2 in ⁴³ Ca.
4720@ 20				
5020@ 20				
5210@ 20		(2,3)		
5430@ 20		(2,3)		
5730@ 20		(2,3)		
6010@ 20	1/2+	0	0.05	
6200@ 20				

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$^{44}\text{Ca}(\text{p},\text{d})$ 1972Ma23,1968Sm05 (continued) **^{43}Ca Levels (continued)**

E(level) [†]	J $\pi^{\ddagger}$	L §	C ² S [#]	Comments
7970 30	(3/2)+	2	0.31	C ² S: 1.1 (1968Sm05). 1978En02 quote S=1.9 (C ² =1/6 for T=5/2). IAS of ^{43}K g.s., 3/2+ (1972Ma23).
8590 30	1/2+	0	0.15	L: from 1972Ma23. 1978En02 quote S=0.9 (C ² =1/6 for T=5/2). Possible IAS of 561 in ^{43}K (1972Ma23).
8760 30	(7/2)-	3	0.07	L: from 1972Ma23. 1978En02 quote S=0.42 (C ² =1/6 for T=5/2). Possible IAS of 738 in ^{43}K (1972Ma23).
9000@ 30	(3/2)-	1	0.006	1978En02 quote S=0.04 (C ² =1/6 for T=5/2). Possible IAS of 975 in ^{43}K (1972Ma23).
9150@ 30	(5/2)+	2	0.05	1978En02 quote S=0.30 (C ² =1/6 for T=5/2). Possible IAS of 1110 in ^{43}K (1972Ma23).
10500@ 30	1/2+	0	0.03	1978En02 quote S=0.18 (C ² =1/6 for T=5/2). Possible IAS of 2451 in ^{43}K (1972Ma23).
10730@ 30				Possible IAS of 2670 in ^{43}K (1972Ma23).
11390@ 30				Possible IAS of 3393 in ^{43}K (1972Ma23).
12060@ 30				Possible IAS of 4022 in ^{43}K (1972Ma23).
12280@ 30				Possible IAS of 4270 in ^{43}K (1972Ma23).
13260@ 30				Possible IAS of 5240 in ^{43}K (1972Ma23).
13700@ 30				
13950@ 30				

[†] From 1966Co06 for levels up to 2050. From 1972Ma23 above 2050.[‡] As given by 1972Ma23.[§] From 1972Ma23.[#] From 1972Ma23 for specified J (typically uncertainty 20%), unless otherwise stated. 1968Sm05 give two sets of values: for zero-range local and for finite-range non-local. The values from the latter set are quoted below under comments. 1978En02 give S-factors (C²=1 for T=3/2, 1/6 for T=5/2).

@ From 1972Ma23 only.

 $^{44}\text{Ca}(\text{d},\text{t})$ 1976Do05,1969Yn01Target ^{44}Ca J $\pi=0+$.1976Do05: E=52 MeV deuteron beam was produced from the Karlsruhe isochronous cyclotron. Target of a 840 $\mu\text{g}/\text{cm}^2$ self-supporting isotopically enriched ^{44}Ca (98.55%). Tritons were detected by ΔE -E counter telescopes consisting of surface-barrier detectors, FWHM=90 keV. Measured $\sigma(\text{E}_\text{t},\theta)$. Deduced levels, J, π , L, spectroscopic factors from DWBA analysis.1969Yn01: E=21.4, 22.6 MeV deuteron beam was produced from the Argonne cyclotron. Target of isotopically enriched CaCO_3 onto a Formvar backing. Tritons were detected by ΔE -E counter telescopes consisting of surface-barrier detectors, FWHM=70-130 keV. Measured $\sigma(\text{E}_\text{t},\theta)$. Deduced levels, J, π , L, spectroscopic factors from DWBA analysis. Data for 12 levels up to 3330.

Others:

1975BrYQ: E=52 MeV. Measured σ .1982KuZU: E=5.8-10 MeV. $\sigma(\theta)$, DWBA analysis. Deduced 1f7/2 neutron-orbital rms radius. **^{43}Ca Levels**Spectroscopic factor: $N^*C^2S=\sigma(\theta)^{\text{exp}}/\sigma(\theta)^{\text{DWBA}}$, where N is the normalization factor. N=3.33 (1976Do05).

E(level) [†]	L ‡	C ² S §	Comments
0.0	3	3.20	C ² S: 4.0 (1969Yn01).
370 20	3	0.15	C ² S: <0.12 (1969Yn01). C ² S: for 1f5/2.
590 20	1	0.07	C ² S: 0.18 (1969Yn01).
990 20	2	2.10 §	C ² S: 2.2 (1969Yn01).
1390 20	2	0.11 §	C ² S: 0.06 (1969Yn01).
1670 20			
1960 20	0	0.75	C ² S: 0.9 (1969Yn01).
2050 20	1	0.11	C ² S: 0.2 (1969Yn01).

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$^{44}\text{Ca}(\text{d,t})$ 1976Do05,1969Yn01 (continued) **^{43}Ca Levels (continued)**

E(level) [†]	L [†]	C ² S [‡]	Comments
2260 20	2	0.15	C ² S: 0.2 for 2300 40 (1969Yn01).
2610 20			
2680 20	2	0.14	C ² S: 0.22 for 2740 40 (1969Yn01).
2850 20	2	0.23	C ² S: 0.3 for 2900 40 (1969Yn01).
3070 20	2	0.56	L,C ² S: L=0, S=0.3 for 3150 40 (1969Yn01).
3270 20	(2)	0.25	C ² S: 0.4 for 3330 40 (1969Yn01).
3610 20			
3960 20	2	0.21	
4210 20	2	0.2	
4270 20	2	0.15	
4730 20	2	0.19	
5220 20			
5360 20			
5730 20	2	0.18	
6020 20	(2)	0.2	
6170 20	(2)	0.24	
7590 20			
7980 20	2	1.0 [§]	1978En02 quote S=6.0 (C ² =1/6 for T=5/2).
8590 20	0	0.25	1978En02 quote S=1.5 (C ² =1/6 for T=5/2).
8770 20	3	0.35	1978En02 quote S=2.1 (C ² =1/6 for T=5/2).
8990 20	1	0.14	1978En02 quote S=0.84 (C ² =1/6 for T=5/2).
9140 30	2	0.2	C ² S: 0.3 for 1d3/2.
			1978En02 quote S=1.8 for d3/2 (C ² =1/6 for T=5/2).
10470 30	0	0.12	1978En02 quote S=0.72 (C ² =1/6 for T=5/2).
10710 30	2	0.2	
11370 30			
12250 30	2	0.2	
13200 30	(2)	0.2	
14190 30			

[†] From 1976Do05.[‡] From 1976Do05. Orbitals used for DWBA calculations are: 2s1/2 for L=0, 2p3/2 for L=1, 1d5/2 for L=2 and 1f7/2 for L=3, unless otherwise stated. 1978En02 give S-factors (C²=1 for T=3/2, 1/6 for T=5/2).[§] For 1d3/2. **$^{44}\text{Ca}(^3\text{He},\alpha),(\text{pol } ^3\text{He},\alpha)$ 1967LyZY,1985Ha08**Target ^{44}Ca J π =0+.1967LyZY (also 1968Ly01,1968Ly02): E=18 MeV ^3He beam was produced from the Heidelberg Emperor-Tandem accelerator. α particles were analyzed with a broad-range magnetic spectrograph (FWHM=50 keV) and detected with a ΔE -E counter telescope. Measured $\sigma(\text{E}_{\alpha},\theta)$. Deduced levels, J, π , L, spectroscopic factors from DWBA analysis.1985Ha08: E=33.1 MeV polarized ^3He beam was produced from the University of Birmingham Radial Ridge Cyclotron.Target of pure self-supporting ^{44}Ca . α particles were detected by telescopes of ΔE -E detectors. Measured $\sigma(\text{E}_{\alpha},\theta)$ and $\text{Ay}(\theta)$ for g.s. and 990 level. Deduced levels, J, π , spectroscopic factors from DWBA analysis.

Others:

1970Pe07: E=10 MeV. Measured $\sigma(\theta)$. Reported six levels with energy (cross section in mb) at 0 (1.60), 370 (0.16), 590 (0.18), 990 (0.65), 1390 (0.07) and 1960 (0.64).1971Ra35: E=13.0 MeV. Measured $\sigma(\theta)$ for g.s. and 990 level. DWBA analysis.1981Gr05: E=50.4 MeV. Measured $\sigma(\theta)$ for g.s. and 990 level. DWBA analysis. **^{43}Ca Levels**

E(level) [†]	J π	L [†]	S [†]	Comments
0.0	7/2- [‡]	3	4.1	S: others: 3.0 2 or 2.4 1 (1985Ha08), 4.2 (1981Gr05), 3.4 (1971Ra35), 3.5 (1968Ly01).
370		3	0.32	
590		1	0.16	
990	3/2+ [‡]	2	3.3	S: others: 1.9 3 or 1.3 2 (1985Ha08), 3.9 (1981Gr05), 2.1 (1971Ra35), 1.9 (1968Ly01).
1390				E(level): from 1970Pe07.
1960		0	1.6	

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$^{44}\text{Ca}(^3\text{He},\alpha),(\text{pol } ^3\text{He},\alpha)$ 1967LyZY,1985Ha08 (continued) **^{43}Ca Levels (continued)**

E(level) [†]	L [†]	S [†]	Comments
2050	1	0.36	
7990	2	9.9	S: for T=5/2.

[†] From 1978En02 (original data from 1967LyZY). 1978En02 state that many L=1 and L=3 transitions to, mostly unresolved, states reported by 1967LyZY in the 2.1–7.9 MeV region are not observed in other studies.

[‡] From Ay(θ) in (pol $^3\text{He},\alpha$) (1985Ha08).

 $^{44}\text{Ca}(^3\text{He},\alpha\gamma)$ 1976Ta04

1976Ta04: E=15 MeV ^3He beam was produced at the University of Pennsylvania. Target of 0.4 mg/cm² enriched ^{44}Ca metal sandwiched between a 0.3 mg/cm² gold backing and a 0.1 mg/cm² gold window. α particles were detected by a surface-barrier position-sensitive detector and γ -rays were detected with an array of 7.6 by 10.2 cm NaI(Tl) crystals. Measured E γ , I γ , $\gamma\gamma$ -coin, $\alpha\gamma$ (θ). Deduced levels, γ -branching ratios, mixing ratios.

Other: 1971HoYN.

 ^{43}Ca Levels

E(level)	J π [†]	E(level)	J π [†]	E(level)	J π [†]
0.0	7/2–	1678	11/2–	3027	(3/2 to 7/2)
373	5/2–	1931	5/2–	3030	(1/2 to 5/2)
593	3/2–	2695	3/2+, 5/2+	3270	(5/2, 7/2)
990	3/2+	2877	1/2–		
1394	5/2+	2943	3/2–		

[†] From Adopted Levels.

 $\gamma(^{43}\text{Ca})$

E(level)	E γ	I γ	Mult. [†]	δ [†]	Comments
373	373	100	D+Q	–0.15 3	$A_2=+0.07$ 4, $A_4=+0.01$ 7. δ : other: –0.18 5 (1971HoYN).
593	220	30	D+Q	–0.10 5	$A_2=+0.01$ 5, $A_4=+0.08$ 8.
	593	70			
990	397	12			
	617	88	D(+Q)	–0.012 17	$A_2=-0.085$ 19, $A_4=-0.012$ 28.
	990	28			
1394	404	13			
	801	6			
	1021	77			
	1394	4			
1678	1678	100			
1931	1338	7			
	1558	33			
	1931	60			
2695	1705	19 9			
	2102	17 9			
	2322	64 11			
2877	2504	≈75			$\delta(Q/D)=+0.10$ 7 for J=3/2, –0.62 10 for J=5/2. But adopted J π (2877)=1/2–. $A_2=-0.21$ 8, $A_4=-0.12$ 14.
2943	1953	24 9			
	2570	68 9			
	2943	8 5			
3027	2654	100	D+Q		$\delta(Q/D)=-0.09$ 6 for J=3/2, –0.37 6 for J=5/2. $A_2=-0.01$ 7, $A_4=+0.21$ 10.
3030	2040	31 9			
	2437	69 9			
3270	1876	17 6			

Continued on next page (footnotes at end of table)

⁴⁴Ca(³He,αγ) 1976Ta04 (continued)

^γ(⁴³Ca) (continued)

E(level)	E _γ	I _γ	Mult. [†]	δ [†]	Comments
3270	2280	49 6	D+Q	+0.07 5	A ₂ =-0.29 11, A ₄ =+0.38 16.
	3270	34 6	D(+Q)	-0.13 13	A ₂ =+0.029 17, A ₄ =+0.18 26.

[†] From ^γ(θ) data.

⁴⁵Sc(μ⁻,2nγ) 1971Ba10

1971Ba10: Muon beam was produced from the muon channel of the CERN synchrocyclotron. γ-rays were detected by two Ge(Li) detectors. Measured E_γ, I_γ. Deduced levels, neutron multiplicity probability.

⁴³Ca Levels

E(level)	Jπ [†]
0.0	7/2-
372.7	5/2-

[†] From Adopted Levels.

^γ(⁴³Ca)

E _γ	E(level)	I _γ [†]
372.7 5	372.7	3.6 10

[†] Absolute intensity per 100 incident particles.

⁴⁵Sc(d,α) 1964Bj01

1964Bj01: E=3-4.3 MeV deuteron beam was produced from an electrostatic generator. Enriched ⁴⁵Sc target. α particles detected by broad-range electromagnetic spectrograph, energy resolution=0.4%. Measured σ(E_α). Deduced levels, Q values.

Other: 1962Ra11, 1967Ha41.

⁴³Ca Levels

E(level)
0.0
385 12
607 12
1009 12
1407 12
1693 12

Adopted Levels, Gammas

Q(β⁻)=-6867 7; S(n)=12138.3 19; S(p)=4929.8 19; Q(α)=-4805.8 19 2012Wa38.
S(2n)=23688.3 19, S(2p)=15206.5 19 (2012Wa38).

2011Av01: E=25-48 MeV. Isotopes produced at IGISOL facility at Jyvaskyla. Measured hyperfine structure, moments, isotope shifts, charge radii by collinear laser spectroscopy. Comparison with shell-model calculations. Known moments for ⁴⁵Sc g.s. used as reference.

⁴³Sc Levels

See (p,γ), (p,p) and (p,p'γ) resonance datasets for additional levels between 5919 keV and 8193 keV.

Cross Reference (XREF) Flags

A ⁴³ Ti ε Decay (509 ms)	H ⁴⁰ Ca(α,pγ)	O ⁴² Ca(³ He,d)
B ²⁴ Mg(²⁴ Mg,αpγ)	I ⁴⁰ Ca(⁶ Li, ³ He)	P ⁴² Ca(¹⁶ O, ¹⁵ N)
C ²⁷ Al(¹⁸ O,2nγ)	J ⁴² Ca(p,γ): Resonances	Q ⁴³ Ca(p,n),(p,nγ)
D ²⁷ Al(¹⁹ F,p2nγ)	K ⁴² Ca(p,γ) E=res	R ⁴³ Ca(³ He,t)
E ²⁸ Si(²⁰ Ne,αpγ)	L ⁴² Ca(p,p): Resonances	S ⁴⁵ Sc(p,t)
F ²⁹ Si(¹⁶ O,pnγ)	M ⁴² Ca(p,p'γ): Resonances	T ⁴⁶ Ti(p,α),(pol p,α)
G ⁴⁰ Ca(α,p)	N ⁴² Ca(d,n)	

E(level) [†]	Jπ [§]	XREF	T _{1/2} [‡]	Comments
0.0 [@]	7/2-	AB CDEFGHI K NOPQRST	3.891 h 12	%ε+%β ⁺ =100. μ=+4.528 10 (2011Av01,2014StZZ). Q=-0.27 5 (2011Av01,2014StZZ). Evaluated rms charge radius=3.558 fm 15 (2013An02). μ,Q: from 2011Av01 (also 2006Ga47) using laser spectroscopy. Others: μ=+4.503 4, Q=-0.208 22 (2006Ga47,laser spectroscopy); μ=+4.61 4, Q=-0.26 6 (1966Co13, atomic-beam method). Adopted (by 1977En02) spectroscopic factor S=0.81 12 (proton stripping). Measured δ<r ² >(⁴⁵ Sc, ⁴³ Sc)=+0.082 fm ² 14(stat) 88(syst) (2011Av01). Jπ: spin from atomic-beam spectroscopy (1966Co13), parity from L(³ He,d)=L(d,n)=3. T _{1/2} : weighted average of 3.92 h 2 (1945Hi04), 3.95 h 2 (1963Du11), and 3.885 h 5 (1969Ra16).
151.79 ^b 8	3/2+	AB DE GH K NO QR T	438 μs 7	%IT=100. μ=+0.348 6 (1977Mi10,2014StZZ). μ: TDPAD method (1977Mi10). Adopted (by 1977En02) spectroscopic factor S=0.35 6 (proton stripping). T _{1/2} : 435 μs 30 (1964Br27). Jπ: L(³ He,d)=L(d,n)=2; M2 γ to 7/2-.
472.60 14	3/2-	A D GHI K NOPQRST	158 ps 13	Adopted (by 1977En02) spectroscopic factor S=0.13 3 (proton stripping). Jπ: L(³ He,d)=L(d,n)=1; E2 γ to 7/2-.
845.18 9	5/2-	AB E GH K O RST	0.15 ps 1	Jπ: L(p,t)=2 from 7/2-; M1+E2 γ to 7/2-; primary γ from 3/2- resonance in (p,γ). 7/2 ruled out by γ(θ) in (α,pγ) and RUL.
855.65 25	1/2+	GH K NO QR T	22 ps 3	Adopted (by 1977En02) spectroscopic factor S=0.08 2 (proton stripping). Jπ: L(³ He,d)=L(d,n)=0.
880.64 ^c 8	5/2+	B DE GH K O QR T	4.6 ps 10	Jπ: M1+E2 γ to 3/2+; γ to 7/2-. Anisotropic γ(θ) rules out 1/2+.
1158.76 24	3/2+	GH K	4.4 ps 10	Jπ: M1+E2 γ to 3/2+; dipole γ to 1/2+. 1/2+ ruled out by anisotropic 1006γ(θ).
1178.98 22	3/2-	GHI K NOPQRST	0.28 ps 11	Adopted (by 1977En02) spectroscopic factor S=0.24 4 (proton stripping). Jπ: L(³ He,d)=L(d,n)=1, γ to 7/2-.
1337.53 ^b 7	7/2+	B DE GH K Q	0.83 ps 35	Jπ: stretched E2 γ to 3/2+.

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)
⁴³Sc Levels (continued)

E(level) [†]	Jπ [§]	XREF	T _{1/2} [‡]	Comments
1408.09& 10	7/2-	AB E GHI K N QRST	0.19 ps 6	XREF: G(1418)N(1395)Q(1424). Jπ: L(p,t)=0 from 7/2-; M1+E2 to 7/2-; γs to 5/2- and 3/2-.
1651.22 25	5/2+	GH K O Q T	0.18 ps 3	XREF: Q(1677). Jπ: M1 γ to 3/2+; γ to 7/2-.
1811.1 4	3/2-	GHI K NOP RS	16 fs 6	Jπ: L(³ He,d)=L(d,n)=1. Anisotropic γ(θ) rules out 1/2.
1830.33@ 11	11/2-	BCDEFGHI RST	0.20 ps 3	Jπ: ΔJ=2, E2 γ to 7/2-. J=3/2 ruled out by γ(θ,lin pol).
1882.8 3	(5/2, 9/2)-	A GH K RS	35 fs 17	Jπ: L(p,t)=2 from 7/2-; M1+E2 γ to 7/2-. J=7/2 ruled out by γ(θ) in (α,pγ). If 1730γ to 151.8, 3/2+ exists, 9/2 will be ruled out.
1912 6		G		
1932.55 ^c 9	9/2+	B DE GH K S	2.4 ps 6	Jπ: L(p,t)=5 from 7/2-; ΔJ=2, E2 to 5/2+; M1+E2 γ to 7/2+.
1962.89 20	(3/2, 5/2)-	A GH K NO	70 fs 11	XREF: N(1947). Jπ: M1+E2 γ to 3/2-; γ(θ) in (p,γ) rules out 1/2, prefers 5/2 over 3/2, L(³ He,d)=L(d,n)=1 support 3/2-. The log ft=6.4 from 7/2- disfavors 3/2-, but the β feeding is small and a strong argument cannot be made to rule out 3/2 completely.
2094.8 3	3/2-	GH K O s	0.29 ps +8-6	Jπ: L(³ He,d)=1; γ to 5/2+. J=1/2 ruled out by γ(θ).
2106.6 5	(3/2, 5/2)	GH K n s	0.21 ps 7	Jπ: γs to 3/2+ and 5/2+; 1/2+ and 7/2+ are possible but, with B(E2)(W.u.)=75, less likely.
2114.5 5		K nO st		XREF: O(?). Jπ: L(p,t)=(3+5) from 7/2- implies positive parity for 2114 and/or 2106; whereas L(d,n)=(1) implies negative parity for one of these levels.
2142.0 3	(3/2-, 5/2+)	GH K t	0.19 ps 4	Jπ: γs to 1/2+ and 7/2-. γ(θ) in (p,γ) prefers 7/2 over 5/2, but γ to 1/2+ and RUL exclude 7/2.
2242.8 6	(3/2, 5/2, 7/2)-	GH RSt	0.19 ps 9	Jπ: L(p,t)=2 from 7/2-; γs to 3/2- and 7/2-.
2288.65 8	5/2-	A GHI K O RS	<21 fs	Jπ: L(³ He,d)=3; γ to 3/2+.
2335.47 10	5/2-	A GH K NO RS	28 fs 14	Jπ: L(d,n)=3; L(p,t)=2 from 7/2-. J=7/2 not allowed by γ(θ) in (α,pγ) and RUL.
2383.1 4	3/2(+)	GH K O	>0.31 ps	Jπ: (M1+E2) γ to 1/2+ and γ(θ) in (α,pγ).
2458.68 10	(5/2, 9/2)-	A GH RS	38 fs 14	Jπ: L(p,t)=2 from 7/2-; ΔJ=1, M1 γ to 7/2-; log ft=4.5 from 7/2-.
2553.54 ^b 11	11/2+	B DE GH K S	0.51 ps 7	Jπ: ΔJ=1, dipole γ to 9/2+, ΔJ=2, Q γ to 7/2+.
2580.8 4	(5/2)	GH K	0.10 ps 3	Jπ: primary transitions from 3/2 and 7/2 resonances in (p,γ).
2606 10		O		
2635.35& 13	(11/2)-	B E GHI RSt	0.21 ps 7	Jπ: L(p,t)=2 from 7/2-; D γ to 11/2-; γ to 7/2-; γ sequence. J=9/2 is not completely ruled out.
2650.5 16		H		E(level): this level may be the same as 2657, 1/2+ level but γ to 5/2- suggests a different level.
2657 10	1/2+	nO t		E(level): see comment for 2650.5 level.
2670.5 4	3/2-	GH K nO RSt		Jπ: L(³ He,d)=0.
2760.10 10	(5/2, 7/2, 9/2)-	A GH RS	<28 fs	Jπ: L(p,t)=2 from 7/2-; γ to 1/2+.
2795.4 5	3/2-, 5/2-	H K S	0.28 ps 16	Jπ: L(p,t)=4 from 7/2-; γ to 7/2-; log ft=4.94 from 7/2-.
2811.1 6	(5/2, 7/2, 9/2)	GH K	<62 fs	Jπ: L(p,t)=2 from 7/2-; γs to 3/2+ and 7/2-; RUL.
				Jπ: γs to 7/2- and 7/2+.

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Adopted Levels, Gammas (continued)
⁴³Sc Levels (continued)

E(level) [†]	Jπ [§]	XREF	T _{1/2} [‡]	Comments
2840.7 5	(5/2, 7/2)+	GH K n S		Jπ: L(p,t)=5 from 7/2-; γs to 7/2- and (3/2)+; inconsistent with L(d,n)=1+3.
2846.2 8		H K n		Jπ: L(d,n)=1+3 for a 2830 group suggests a doublet with Jπ=1/2-, 3/2- and 5/2-, 7/2- near this energy.
2860.8 4	(1/2, 3/2, 5/2)+	H K S		Jπ: L(p,t)=3 from 7/2-; γ transitions to 3/2- and 5/2+.
2874.7 6	(5/2)+	K O T		XREF: T(2870). Jπ: fit to σ(θ) and Ay in (pol p,α) gives 5/2+, 9/2+; γ to 3/2+ disfavors 9/2+.
2930?	3/2+, 5/2+	N		Jπ: L(d,n)=2.
2985.0 5	(3/2, 5/2)	H K NO Rs	54 fs 11	Jπ: γs to 3/2+, 5/2-, 5/2+ and 3/2-.
2988.12 [@] 12	15/2-	BCDEFGHI sT	5.6 ps 7	Jπ: ΔJ=2, E2 γ to 11/2-.
3123.73 [@] 15	19/2-	BCDEFGHI RST	472 ns 4	μ=+3.122 7 (1978Ha07, 2014StZZ). Q=0.199 14 (1981Da06, 2014StZZ, 2013StZZ). Jπ: L(p,t)=6 from 7/2-; ΔJ=2, E2 γ to 15/2-.
				μ, Q: TDPAD method (1978Ha07, 1981Da06). Others: μ=3.108 18 (1994Zh43), 3.15 2 (1971Na10).
3142.05 ^c 12	13/2+	B DE GH	>0.55 ps	Jπ: ΔJ=2, E2 γ to 9/2+; γ to 11/2+.
3159.3 5	(3/2-, 5/2, 7/2+)	H K	<0.42 ps	Jπ: γs to 7/2- and 3/2+.
3198.2 10	(1/2 to 7/2-)	H O S	<0.28 ps	Jπ: 1/2, 3/2, 5/2, 7/2- from γ to 3/2-.
3260.1 8	(7/2, 9/2)-	A GH K O RS	42 fs 25	Jπ: L(p,t)=4 from 7/2-; log ft=5.9 from 7/2-; possible γ to 11/2-.
3292.4 3	7/2-	B E GH K S		Jπ: L(p,t)=2 from 7/2-; γs to 3/2- and 9/2+.
				T _{1/2} : values <3.5 fs from (p,γ) and >55 fs from (α, pγ) are discrepant.
3326.8 8	(3/2- to 9/2)	K no Rs		Jπ: γ to 7/2-; γ from 6696, 5/2. L(³ He, d)=3 for a 3328 group gives 5/2-, 7/2- for 3327 or 3332 level. L(p,t)=2 from 7/2- gives negative parity for one or both these levels.
3332.2 4	(3/2-, 5/2)	H K no s	0.13 ps 10	Jπ: γs to 3/2-, 5/2- and 3/2+; possible γ to 7/2-. L(d,n)=3 for a 3330 group suggests 5/2-, 7/2- for one of the levels near this energy.
3375.3 5	(7/2, 9/2)-	H K S	<62 fs	Jπ: L(p,t)=2 from 7/2-; γs to 7/2-, 7/2+ and 11/2-.
3452.1 5	5/2+	gH K No S	<2.1 fs	Jπ: L(d,n)=2; L(p,t)=5 from 7/2-; 3/2+ ruled out by γ to 7/2- and RUL.
3463.3 6	5/2-	gH K O r T		XREF: O(3474).
3480 10	(≤13/2)+	G L rSt		Jπ: L(³ He, d)=3; γ to 3/2+.
3503.2 6	7/2-	K O S		Jπ: L(p,t)=3 from 7/2-.
3613 10		nO		Jπ: L(p,t)=0 from 7/2-.
3631.7 10	(5/2-, 7/2-, 9/2-)	A n		Jπ: possible allowed ε feeding from 7/2-.
3645.6 5	(3/2, 5/2, 7/2-)	K		Jπ: γs to 5/2+, 5/2- and 3/2-.
3683.2 5	(3/2, 5/2, 7/2)	G K NO RS		E(level), Jπ: L(p,t)=3 from 7/2- implying positive parity and L(³ He, d)=L(d,n)=3 implying 5/2-, 7/2- require two separate levels near this energy. 7/2- is not likely from γ to 3/2+.
3700 10	(5/2 to 19/2)-		S	Jπ: L(p,t)=6 from 7/2-.
3734.0 5		K		
3755.43 ^b 16	15/2+	B DE		Jπ: ΔJ=2, Q γ to 11/2+; ΔJ=1, M1+E2 γ to 13/2+.
3756.5 5	(3/2-, 5/2, 7/2+)	K		Jπ: γs to 3/2+ and 7/2-.
3771 10	(3/2 to 17/2)+	S		Jπ: L(p,t)=5 from 7/2-.
3807.2 4	7/2-	G K O ST	<3.5 fs	XREF: O(3786). Jπ: ΔJ=1 γ to 5/2+; γs to 3/2- and 7/2+; 3/2+ excluded by RUL. L(p,t)=5 from 7/2- for 3807 group is incompatible.

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Adopted Levels, Gammas (continued)
⁴³Sc Levels (continued)

E(level) [†]	Jπ [§]	XREF			T _{1/2} [‡]	Comments
3843.0 6	(≤9/2)	g	K	Rs		Jπ: γ to 5/2-. L(p,t)=5 from 7/2- implies positive parity for 3843 or 3860 level.
3860.1 6	(≤7/2)	g	K	s		Jπ: γ to 3/2+. See also comment for 3843 level.
3894 8				R		
3939 10	5/2-, 7/2-	g		NO R		Jπ: L(³ He,d)=L(d,n)=3.
3949 10	(≤13/2)+	gH		S		Jπ: L(p,t)=3 from 7/2-.
3959.87& 12	15/2-	B E				XREF: H(3956)S(3949).
3985 10		G		O		Jπ: ΔJ=2, Q γs to 11/2-; D γ to 15/2-.
4007.3 5	(3/2, 5/2)+		K N	S		Jπ: L(p,t)=5 from 7/2-; γs to 1/2+ and 5/2+.
4038.8 6	7/2-		K	S		Jπ: L(p,t)=4 from 7/2-; γs to 3/2- and 9/2+.
4132 8	(3/2 to 17/2)+			RS		Jπ: L(p,t)=5 from 7/2-.
4158.6 10	(9/2, 11/2, 13/2)-	GH		S		E(level): population uncertain in (³ He,t).
4211 10	(9/2, 13/2)+			ST		Jπ: L(p,t)=4 from 7/2-; γ to 11/2+.
						XREF: T(4180).
						Jπ: L(p,t)=3 from 7/2-; σ(θ) and Ay in (pol p,α).
4236 8	7/2-			NO RST		Jπ: L(p,t)=0 from 7/2-; L(³ He,d)=L(d,n)=3.
			K	R		T=3/2.
4276 8						XREF: K(4272).
4301.2 5	(9/2, 11/2, 13/2+)	B E				Jπ: γ to 9/2+.
4343 8				R		
4360	(17/2-)			T		Jπ: σ(θ) and Ay in (pol p,α).
4371.5 5	5/2-, 7/2-	G K	O	R		XREF: O(4363).
						Jπ: L(³ He,d)=3. γ(θ) in (p,γ) preferred 7/2+.
4383 9	5/2-, 7/2-			NO		Jπ: L(³ He,d)=L(d,n)=3.
4383.03 23	17/2(-)	B DE			40 fs 17	Jπ: D γ to 15/2-; D+Q γ to 19/2-.
4430.2 5	(1/2+, 3/2, 5/2)		K			Jπ: γs to 3/2-, 3/2+ and 5/2+.
4455.3 8	(5/2 to 9/2)		K		<3.5 fs	Jπ: ΔJ=1 γ to 7/2-.
4511 8				R		
4555 10	(11/2+, 13/2-)			O T		Jπ: σ(θ) and Ay in (pol p,α).
4583 10				NO T		
4633.6 19	(17/2, 21/2)	D			<110 fs	Jπ: ΔJ=1 γ to 19/2-.
4660 8	1/2-, 3/2-	G		NO RS		XREF: G(4630).
						Jπ: L(³ He,d)=L(d,n)=1.
4700	(15/2+)			T		Jπ: σ(θ) and Ay in (pol p,α).
4719 9	1/2-, 3/2-			NO		Jπ: L(³ He,d)=L(d,n)=1.
4766 8	1/2-, 3/2-			O R		Jπ: L(³ He,d)=1.
4817 8	1/2-, 3/2-			O R		Jπ: L(³ He,d)=1.
4873 8				O R		
4893 9	1/2-, 3/2-			NO		Jπ: L(³ He,d)=1.
4927 10		G		O		
5018 9	1/2-, 3/2-			NO		Jπ: L(³ He,d)=L(d,n)=1.
5187 10				O		E(level): due to improbable L(³ He,d)=8 required for 17/2+, the 5187 level in (³ He,d) is considered as different from 5200.
5200	(17/2+)			T		Jπ: σ(θ) and Ay in (pol p,α).
5231.33 ^c 17	(17/2+)	B DE				Jπ: ΔJ=1 γ to 15/2+; γ sequence.
5236 10		G		ST		
5258 10	1/2-, 3/2-			NO		Jπ: L(³ He,d)=L(d,n)=1.
5317 10		G		O		
5446 10				O		
5502 9	1/2-, 3/2-			NO		Jπ: L(³ He,d)=L(d,n)=1.
5519.00 ^b 15	19/2+	B DEF			<62 fs	Jπ: ΔJ=2, E2 γ to 15/2+; ΔJ=1, dipole γ to 19/2-.
5530 10	1/2-, 3/2-			O		Jπ: L(³ He,d)=1.
5641 9	1/2-, 3/2-			NO		Jπ: L(³ He,d)=L(d,n)=1.
5719 9	1/2-, 3/2-	G		NO		Jπ: L(³ He,d)=L(d,n)=1.
5793.51 24	(15/2, 17/2, 19/2-)	B E				Jπ: γ to 15/2-.
5823 9				NO		

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Adopted Levels, Gammas (continued)
⁴³Sc Levels (continued)

E(level) [†]	Jπ [§]	XREF	T _{1/2} [‡]	Comments
5871 10		O		
5919.4 4	3/2	JK O		Jπ: γ(θ) in (p,γ).
5950.5 3	(3/2, 5/2)	JK		Jπ: γ(θ) in (p,γ).
5977 12		NO		
6033 9	1/2-, 3/2-	NO		Jπ: L(³ He,d)=L(d,n)=1.
6060.5 10	(5/2)	JK		Jπ: γ(θ) in (p,γ).
6067.23& 14	19/2-	B DE	55 fs 12	Jπ: ΔJ=2, E2 γs to 15/2-, γ sequence.
6079 10		G O		
6103.2 3	(3/2-, 5/2+)	JK O		Jπ: from γ decay of resonance in (p,γ).
6116		J		
6127		J		
6136.2 3	3/2	JK		Jπ: from γ(θ) in (p,γ).
6143.4 3	3/2-	JK		Jπ: γ decay of resonance and γ(θ) in (p,γ).
6146 3	1/2-, 3/2-	J NO		T=3/2.
				Jπ: L(³ He,d)=L(d,n)=1.
6151 3	3/2-	J L N		Γ=125 eV 15.
				Jπ: from fit to resonance in (p,p).
6172.98 ^a 17	(19/2+)	B E		Jπ: γs to 15/2+, 19/2+ and 19/2-; γ sequence.
6174		J		
6182		J		
6184.2 10	5/2	JK		Jπ: γ decay of resonance and γ(θ) in (p,γ).
6190		J		
6198.1 4	(3/2, 5/2+)	JK		Jπ: γ decay of resonance and γ(θ) in (p,γ).
6200		J		
6210		J		
6211		J		
6217.4 3	(3/2-, 5/2+)	JK		Jπ: γ decay of resonance and γ(θ) in (p,γ).
6223	1/2+	L T		T=3/2.
				Jπ: fit to resonance in (p,p).
				Γ=50 eV 10.
6228 3		G J		
6242		J		
6247.2 4	(3/2, 5/2)	JK		Jπ: γ decay of resonance and γ(θ) in (p,γ).
6253		J		
6262		J		
6280 3		J O		
6283.49 ^c 17	(21/2+)	B DE	110 fs 38	Jπ: γ to (17/2+); ΔJ=1, D γ to 19/2- and 19/2+.
6286		J		
6291		J		
6297		J		
6312		J		
6315		J		
6320.4 3	5/2+	JK		Jπ: γ decay of resonance and γ(θ) in (p,γ).
6348		J		
6355		J		
6370		J		
6374		J		
6384 3		J O		
6391		J		
6395		J		
6403		J		
6410		J		
6416		J		
6417.6		J L		
6426		J		
6431.04 ^b 17	23/2+	B DEF	16.3 ps 15	Jπ: ΔJ=2, E2 γ to 19/2+; γ to 19/2-.
6432		J		
6439 3	1/2+	J L O		Γ=1.5 eV 5.
				Jπ: fit to resonance in (p,p).
6453		J		
6461		J		

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Adopted Levels, Gammas (continued)

 ^{43}Sc Levels (continued)

E(level) [†]	J π [§]	XREF	T _{1/2} [‡]	Comments
6469		J		
6479		J		
6481		J		
6493		J		
6499		J		
6503		J		
6508		J		
6510.7	1/2 ⁺ #	L		
6515		J		
6535		J		
6547		J		
6551		J		
6558		J		
6561.4	1/2 ⁻ #	L		
6564.1	1/2 ⁺ #	J L		
6570.1	1/2 ⁺ #	J L		
6576		J		
6584		J		
6596		J		
6604		J		
6625		J		
6630.0	1/2 ⁻ #	J L		
6651.0	1/2 ⁺ #	L		
6665		J		
6674		J		
6677.4	(1/2 ⁻)#	J L		
6680		J		
6684.4	1/2 ⁺ #	L		
6685.1 4	1/2 ⁻	JK		T=1/2&3/2. J π : γ decay of resonance and $\gamma(\theta)$ in (p, γ).
6685.3	3/2 ⁻ #	L		
6694.8	1/2 ⁻ #	J L		
6696.2 3	5/2	JK		J π : γ decay of resonance and $\gamma(\theta)$ in (p, γ).
6709 3	1/2 ⁻	jkL o		J π : γ decay of resonance in (p, γ). T=1/2&3/2.
6709.5	1/2 ⁻ #	jkL o		
6713		J		
6716		J		
6719		J		
6730		J		
6736.6	3/2 ⁻ #	J L		
6749		J		
6759		J		
6777.3 3	5/2	JK N		J π : γ decay of resonance and $\gamma(\theta)$ in (p, γ); L(d,n)=1 is inconsistent.
6786		J		
6794		J		
6795.1	1/2 ⁻ #	L		
6795.4	1/2 ⁻ #	L		
6801		J		
6811 10		O		
6814		J		
6814.5 19	(15/2 ⁻ to 23/2 ⁻)	D	94 fs 20	
6815.3	1/2 ⁺ #	L		
6818.42 17	(21/2 ⁺)	B E		J π : γ s to (17/2 ⁺) and (19/2 ⁺).
6827.0	3/2 ⁻ #	L		
6830		J		
6834		J		
6846		J		
6849.7	(3/2 ⁺)#	L		
6850.8	1/2 ⁻ #	L		
6853.9	(3/2 ⁺)#	L		
6855.0	1/2 ⁻ #	J L		

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Adopted Levels, Gammas (continued)
 ^{43}Sc Levels (continued)

E(level) [†]	Jπ [§]	XREF	T _{1/2} [‡]	Comments
6859.0	(3/2 ⁺) [#]	L		
6861		J		
6868.2	1/2 ⁺ [#]	L		
6871		J		
6877		J		
6880.1	1/2 ⁺ [#]	J L		
6889		J		
6899.7	1/2 ⁻ [#]	J L		XREF: J(6901).
6906		J		
6912.4	1/2 ⁺ [#]	J L		
6918.6 4	7/2	K O		Jπ: γ decay of resonance and γ(θ) in (p,γ).
6920		J		
6925		J		
6934		J		
6936.4	1/2 ⁺ [#]	L		
6942		J		
6943.7	1/2 ⁻ [#]	L		
6946		J		
6961		J		
6966.0	(3/2 ⁺) [#]	J L		
6971		J		
6978.9	(3/2 ⁺) [#]	J L		
6983.6	1/2 ⁻ [#]	J L		
6991		J		
6996		J		
6999		J		
7004		J		
7013.7	(3/2 ⁻) [#]	J L		XREF: J(7015).
7022		J		
7024.7	(3/2 ⁺) [#]	J L		
7027.7	1/2 ⁻	L N		Jπ: fit to resonance in (p,p); L(d,n)=1.
7032.1	1/2 ⁺ [#]	L		
7033		J		
7037.2	3/2 ⁻ [#]	L		
7042		J		
7046.4	(5/2 ⁺) [#]	L		
7051		J		
7058		J		
7063		J		
7067.5	1/2 ⁺ [#]	L		
7072		J		
7074.9	1/2 ⁻ [#]	L		
7080		J		
7085.6	1/2 ⁻ [#]	L		
7091		J		
7094.4	3/2 ⁻ [#]	J L		
7099.1	1/2 ⁺ [#]	J L		
7106.88 ^a 17	(23/2 ⁺)	B DE		Jπ: ΔJ=1, D γ to (21/2 ⁺); γ to (19/2 ⁺).
7108		J		
7116.8	1/2 ⁻ [#]	J L		XREF: J(7118).
7118.8 11	(15/2, 17/2, 19/2 ⁺)	B E		Jπ: γ to 15/2 ⁺ .
7123.4	(3/2 ⁺) [#]	L		
7125.0	1/2 ⁺ [#]	L		
7127		J		
7132.3	(3/2 ⁺) [#]	L		
7135		J		
7138.0	3/2 ⁻ [#]	L		
7140.2	1/2 ⁺ [#]	J L		
7146		J		
7150.5	(3/2 ⁺) [#]	L		
7154		J		
7155.8	3/2 ⁻ [#]	L		
7159	3/2 ⁺ , 5/2 ⁺	J N		Jπ: L(d,n)=2.

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Adopted Levels, Gammas (continued) ^{43}Sc Levels (continued)

E(level) [†]	J π [§]	XREF	T _{1/2} [‡]	Comments
7170.2	1/2- [#]	J L		
7174		J		
7176.5	(5/2-) [#]	J L		
7180		J		
7183		J		
7185.2	(3/2+) [#]	L		
7198		J		
7211.0	(1/2-) [#]	J L		
7214		J		
7215.3	(1/2+) [#]	L		
7222.9	3/2+ [#]	J L		
7227.1	(3/2+) [#]	J L		
7231.2	1/2- [#]	L		
7240.8	(3/2+) [#]	J L		
7247.5	1/2- [#]	L		
7251.0	(3/2+) [#]	J L		
7255.4	1/2+ [#]	L		
7256.8	3/2- [#]	L		
7263		J		
7266.3	(3/2+) [#]	L		
7269		J		
7273.5 7	(15/2, 17/2, 19/2+)	B E		J π : γ to 15/2+.
7275		J		
7281.0	(1/2-) [#]	J L		
7285		J		
7288		J		
7289.8	3/2+ [#]	L		
7290.9	(3/2+) [#]	L		
7295		J		
7302		J		
7305		J		
7307.6	3/2- [#]	L		
7309.1	1/2- [#]	L		
7311.2	(3/2+) [#]	L		
7313		J		
7315.8	1/2+ [#]	L		
7326.9	1/2- [#]	L		
7329.5	(3/2+) [#]	L		
7339.4	1/2+ [#]	L		
7344.1 3	3/2-, 5/2	JK		J π : γ decay of resonance and $\gamma(\theta)$ in (p, γ).
7349		J		
7354		J		
7359.16 ^c 17	(25/2)+	B DEF	340 fs 2 I	J π : $\Delta J=1$, M1 γ to 23/2+; γ to (21/2+).
7363.5	1/2+ [#]	L		
7365.1	1/2- [#]	J L		
7369.7	1/2- [#]	L		
7370.8	1/2- [#]	L		
7373		J		
7378.5	1/2+ [#]	L		
7380	1/2-, 3/2-	N		J π : L(d,n)=1.
7382		J		
7385.5	(5/2-) [#]	L		
7388		J		
7390.3	1/2+ [#]	L		
7394.18 23	3/2-, 5/2+	JK		J π : γ decay of resonance and $\gamma(\theta)$ in (p, γ).
7395.7	3/2+ [#]	L		
7402		J		
7412.4	1/2- [#]	J L		XREF: J(7411).
7414.5	(3/2+) [#]	J L		
7419.4	3/2- [#]	J L		XREF: J(7418).
7423		J		
7424.7	5/2+ [#]	L		
7429		J		

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Adopted Levels, Gammas (continued)
 ^{43}Sc Levels (continued)

E(level) [†]	Jπ [§]	XREF	T _{1/2} [‡]	Comments
7433		J		
7439.9	5/2+ [#]	L		
7443		J		
7445.0	1/2+ [#]	L		
7448.4	1/2- [#]	L		
7450		J		
7461.7	(3/2+) [#]	L		
7463.7	3/2- [#]	L		
7466		J		
7471		J		
7476.6	1/2- [#]	L		
7477.1	(5/2+) [#]	L		
7478.6	3/2- [#]	J L		XREF: J(7480).
7483.8	(5/2-) [#]	J L		
7492.0	1/2+ [#]	J L		
7498		J		
7502.0	(5/2-) [#]	J L		
7508.5	3/2- [#]	L		
7512.3 4	(7/2+)	JKL		Jπ: γ decay of resonance and γ(θ) in (p,γ). 1/2- from (p,p) is inconsistent which may indicate a separate level.
7513		J		
7517.6	(5/2+) [#]	J L		
7522		J		
7527.5	(3/2-) [#]	L		
7530	1/2-, 3/2-	J L N		Jπ: L(d,n)=1; (3/2-) from (p,p).
7536		J		
7539.1	3/2- [#]	L		
7540.0	1/2+ [#]	L		
7544		J		
7551		J		
7557.1	(5/2+) [#]	L		
7559		J		
7560.2	3/2- [#]	L		
7564.1	(3/2+) [#]	J L		
7570.1	1/2+ [#]	L		
7581.4 4	(3/2-, 5/2, 7/2+)	JK		Jπ: γ decay of resonance and γ(θ) in (p,γ).
7586.6	1/2- [#]	L		
7592		J		
7595.5	(3/2+) [#]	L		
7596.9	1/2- [#]	L		
7599.6	1/2+ [#]	J L		
7604.5	(3/2+) [#]	J L		XREF: J(7603).
7607		J		
7611		J		
7614.2	3/2- [#]	L		
7615.6	(1/2-) [#]	L		
7619.5	1/2- [#]	J L		XREF: J(7418).
7620.8	(3/2+) [#]	L		
7624		J		
7625.8	(3/2+) [#]	L		
7627.1	(5/2+) [#]	L		
7630.7	3/2- [#]	L		
7639.4	3/2- [#]	L		
7644.1	(3/2+) [#]	L		
7646.1	(3/2+) [#]	L		
7659.6	3/2- [#]	L		
7666.6	1/2+ [#]	L		
7668.0	1/2+ [#]	L		
7675.7	3/2- [#]	L		
7683.6	(5/2-) [#]	L		
7693.2	1/2- [#]	L		
7700	5/2-, 7/2-	N		Jπ: L(d,n)=3.

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Adopted Levels, Gammas (continued) ^{43}Sc Levels (continued)

E(level) [†]	J π [§]	XREF	T _{1/2} [‡]	Comments
7703.3	(5/2 ⁺) [#]	L		
7708.3	1/2 ⁺ [#]	L		
7711.1	1/2 ⁻ [#]	L		
7714.8	(5/2 ⁻) [#]	L		
7721.7	1/2 ⁻ [#]	L		
7733.7	(5/2 ⁺) [#]	L		
7738.3	1/2 ⁻ [#]	L		
7738.5	1/2 ⁺ [#]	L		
7744.3	3/2 ⁻ [#]	L		
7747.3	1/2 ⁻ [#]	L		
7751.4	1/2 ⁻ [#]	L		
7754.0	(5/2 ⁺) [#]	L		
7760.9	(5/2 ⁺) [#]	L		
7761.3	1/2 ⁻ [#]	L		
7769.4	1/2 ⁺ [#]	L		
7784.7	(3/2 ⁺) [#]	L		
7785.3	(5/2 ⁻) [#]	L		
7797.5	(5/2 ⁺) [#]	L		
7803.6	1/2 ⁺ [#]	L		
7807.2	3/2 ⁻ [#]	L		
7807.7	1/2 ⁻ [#]	L		
7810.8	(3/2 ⁺) [#]	L		
7815.6	(5/2 ⁺) [#]	L		
7818.6	1/2 ⁺ [#]	L		
7819.0	1/2 ⁺ [#]	L		
7820.5	(5/2 ⁺) [#]	L		
7829.6	1/2 ⁻ [#]	L		
7830.3	3/2 ⁻ [#]	L		
7832.0	(5/2 ⁻) [#]	L		
7832.8	(3/2 ⁺) [#]	L		
7836.2	(5/2 ⁻) [#]	L		
7838.0	(3/2 ⁺) [#]	L		
7841.4	1/2 ⁺ [#]	L		
7844.2	3/2 ⁻ [#]	L		
7850.5	3/2 ⁻ [#]	L		
7859.2	1/2 ⁻ [#]	L		
7859.8	1/2 ⁻ [#]	L		
7861.6	3/2 ⁺ [#]	L		
7868.5	3/2 ⁻ [#]	L		
7900	5/2 ⁻ , 7/2 ⁻	N		J π : L(d,n)=3.
7919	3/2 ⁺ , (5/2 ⁺) [#]	L		
7926	1/2 ⁻ , (3/2 ⁻) [#]	L		
7933	1/2 ⁺ [#]	L		
7941	1/2 ⁺ [#]	L		
7954	1/2 ⁻ , (3/2 ⁻) [#]	L		
7961	1/2 ⁻ , (3/2 ⁻) [#]	L		
8010.1 4	(19/2, 21/2, 23/2 ⁺)	B E		J π : γ to 19/2 ⁺ .
8014	1/2 ⁻ [#]	L		
8019	(3/2 ⁺ , 5/2 ⁺) [#]	L		
8021		M		
8027		M		
8034	(3/2 ⁺ , 5/2 ⁺) [#]	L		
8045	(3/2 ⁺ , 5/2 ⁺) [#]	L		
8048	1/2 ⁺ [#]	L		
8054		M		
8061	1/2 ⁻ [#]	L		
8063		M		
8065	3/2 ⁻ , (1/2 ⁻) [#]	L		
8068	3/2 ⁻ [#]	M		
8071	3/2 ⁻ [#]	L		
8074	3/2 ⁻ [#]	M		
8075	9/2 ⁺ , (7/2 ⁺) [#]	L		
8093		M		

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Adopted Levels, Gammas (continued) ^{43}Sc Levels (continued)

E(level) [†]	J π [§]	XREF	T _{1/2} [‡]	Comments
8111	5/2 ⁻ , 7/2 ⁻	MN		J π : L(d,n)=3.
8122		M		
8132		M		
8139		M		
8149		M		
8193		M		
8380	5/2 ⁻ , 7/2 ⁻	N		J π : L(d,n)=3.
8434.37 17	23/2 ⁻ (-)	B E		J π : $\Delta J=2$, Q γ to 19/2 ⁻ .
8555.56& 19	23/2 ⁻ (-)	B E		J π : $\Delta J=2$, Q γ to 19/2 ⁻ ; γ sequence.
8690	5/2 ⁻ , 7/2 ⁻	N		J π : L(d,n)=3.
8703.06 18	(25/2 ⁺)	B DE		J π : $\Delta J=1$, D γ to 23/2 ⁺ .
8831.84 ^b 18	(27/2 ⁺)	B DE	74 fs 15	J π : $\Delta J=1$, D γ to (25/2 ⁺); γ to (23/2 ⁺).
8910	5/2 ⁻ , 7/2 ⁻	N		J π : L(d,n)=3.
9170	5/2 ⁻ , 7/2 ⁻	N		J π : L(d,n)=3.
9218.8 4	(21/2 ⁻)	B E		J π : (D) γ to 19/2 ⁻ .
9450	5/2 ⁻ , 7/2 ⁻	N		J π : L(d,n)=3.
9578.86 20	(27/2 ⁺)	B E		J π : γ s to (25/2 ⁺) and 23/2 ⁺ .
9750	5/2 ⁻ , 7/2 ⁻	N		J π : L(d,n)=3.
9995.10 20	(25/2 ⁻)	B E		J π : $\Delta J=1$, D γ to 23/2 ⁻ ; γ to (23/2 ⁺).
10040	5/2 ⁻ , 7/2 ⁻	N		J π : L(d,n)=3.
10084.47 17	27/2 ⁻ (-)	B E		J π : $\Delta J=1$, D γ to (25/2 ⁺); $\Delta J=2$, Q γ to 23/2 ⁻ .
10178.6 6	(23/2, 25/2, 27/2 ⁺)	B E		J π : γ to (23/2 ⁺).
10230	3/2 ⁺ , 5/2 ⁺	N		J π : L(d,n)=2.
10436.84 ^a 23	(25/2 ⁺)	B E		J π : γ to (23/2 ⁺); member of a sequence based on (19/2 ⁺).
10613.21 19	(27/2 ⁻)	B E		J π : $\Delta J=1$, D γ to (25/2 ⁺); $\Delta J=2$, Q γ to 23/2 ⁻ (-).
10750	5/2 ⁻ , 7/2 ⁻	N		J π : L(d,n)=3.
10856.18 19	(27/2 ⁻)	B E		J π : $\Delta J=1$ D γ s to (25/2 ⁻) and (25/2 ⁺).
10910	5/2 ⁻ , 7/2 ⁻	N		J π : L(d,n)=3.
11252.0 4	(25/2 ⁺)	B E		J π : $\Delta J=(0)$ γ to (25/2 ⁺) from $\gamma(0)$.
11260	5/2 ⁻ , 7/2 ⁻	N		J π : L(d,n)=3.
11355.60& 23	27/2 ⁻ (-)	B E		J π : $\Delta J=2$, Q γ to 23/2 ⁻ ; γ to (25/2 ⁺); γ sequence.
11560	5/2 ⁻ , 7/2 ⁻	N		J π : L(d,n)=3.
11661.0 5		B E		
11807.36 19	(29/2 ⁻)	B E		J π : $\Delta J=1$ γ s to (27/2 ⁺) and (27/2 ⁻).
11840	1/2 ⁻ , 3/2 ⁻	N		J π : L(d,n)=1.
11920.54 25	(25/2 ⁺)	B E		J π : D γ s to 23/2 ⁺ and (25/2 ⁺).
12053.33 19	(29/2 ⁻)	B E		J π : $\Delta J=1$, D γ to 27/2 ⁻ (-); γ to (25/2 ⁻).
12073.15 21	(29/2 ⁻)	B E		J π : $\Delta J=1$, D γ to 27/2 ⁻ (-).
12090	1/2 ⁻ , 3/2 ⁻	N		J π : L(d,n)=1.
12614.84 19	(31/2 ⁻)	B E		J π : $\Delta J=2$, Q γ to 27/2 ⁻ (-).
12703.9 9		B E		
12804.39 24	(27/2, 29/2)	B E		J π : γ s to 27/2 ⁻ (-) and (27/2 ⁺).
13044.65 ^a 22	(29/2 ⁺)	B E		J π : $\Delta J=1$, D γ to (27/2 ⁺); γ to (25/2 ⁺).
13116.57 21	(31/2 ⁻)	B E		J π : $\Delta J=2$, Q to 27/2 ⁻ (-); $\Delta J=1$, D γ to (29/2 ⁻).
13122.7 6		B E		
13584.1 4	(29/2 ⁺)	B E		J π : $\Delta J=1$, D γ to (27/2 ⁺).
14405.80 19	(33/2 ⁻)	B E		J π : $\Delta J=1$, D γ to (31/2 ⁻); $\Delta J=2$, Q γ to (29/2 ⁻).
14451.1 3	(29/2 ⁺)	B E		J π : γ s to (25/2 ⁺) and (27/2 ⁺).
14561.2& 3	(31/2 ⁻)	B E		J π : γ to (29/2 ⁻); $\Delta J=2$, Q γ to 27/2 ⁻ (-); γ sequence.
14914.3 3	(31/2)	B E		J π : $\Delta J=2$, Q γ to (27/2 ⁺).
15910.7 ^a 3	(33/2 ⁺)	B E		J π : γ s to (29/2 ⁺) and 31/2 ⁻ .
16703.6 6		B E		
16708.4 5		B E		
16711.2 6		B E		
17767.4 3	(35/2)	B E		J π : $\Delta J=(2)$, (Q) γ to (31/2).
17921.1 4	(31/2 ⁺)	B E		J π : $\Delta J=1$, (D) γ to (29/2 ⁺).

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)
⁴³Sc Levels (continued)

E(level) [†]	Jπ [§]	XREF	Comments
18196.8 ^{& 5}	(35/2-)	B E	Jπ: ΔJ=2, Q γ to (31/2-).
18765.3 ⁴	(37/2)	B E	Jπ: ΔJ=1, D γ to (35/2).
19208.6 ^{a 4}	(37/2+)	B E	Jπ: γ to (33/2+).

[†] From adopted E_γ data when measured γ-ray energies are available. In other cases weighted averages are taken of values available from different reactions. Values for proton resonances in (p,γ) and (p,p) reactions are considered to be associated with different excitation energies if separated by more than ~1 keV. Relative uncertainty of excitation energies deduced from proton resonances is 0.1 keV in (p,p) and 1 keV in (p,γ), whereas the absolute uncertainty is 2 keV, essentially due to uncertainty in S(p).

[‡] Weighted averages from (α,pγ), (p,γ), (¹⁶O,pnγ) and (¹⁹F,p2nγ) unless otherwise noted.

[§] In particle-transfer reactions, target Jπ=0+ except for ⁴⁵Sc(p,t) where target Jπ=7/2-. When assigning Jπ to a level based on γ transitions from this level to a level of known Jπ, evaluators use the following rules: if E_γ<4 MeV, transitions are only considered to be E1,M1 or E2; if E_γ>4 MeV, M2 and E3 are considered to be possible. In heavy-ion fusion experiments leading to high-spin (>13/2 or so) it is assumed that spins generally ascend with excitation energy due to yrast nature of population of levels in such studies.

From (p,p) resonance.

@ (A): γ sequence based on g.s.

& (B): γ sequence based on 7/2-.

a (C): γ sequence based on (19/2+).

b (D): γ sequence based on 3/2+.

c (E): γ sequence based on 5/2+.

^γ(⁴³Sc)

E(level)	E _γ [†]	I _γ [§]	Mult. # [@]	δ [@]	α	Comments
151.79	151.65 ¹⁷	100	M2		0.0406	Mult.: from α(expt)=0.041 ⁴ (1972Bi13) in ⁴³ Ca(p,nγ); α(K)(expt)=0.031 ² , K/L(expt)=9.0 ⁷ (1966WaZW) in ⁴⁰ Ca(α,pγ). B(M2)(W.u.)=0.0691 ¹¹ . B(E1)(W.u.)=4.3×10 ⁻⁶ 12.
472.60	320.1	4.2 ¹¹	[E1]			B(E1)(W.u.)=4.3×10 ⁻⁶ 12.
	472.5 ²	100.0 ²¹	E2			Mult.: from α(K)(expt)=7.7×10 ⁻⁴ 19 (1966WaZW) in ⁴⁰ Ca(α,pγ). B(E2)(W.u.)=16.3 ¹⁵ . E _γ I _γ : as quoted by 1978En02.
845.18	373.2	<5				E _γ I _γ : as quoted by 1978En02.
	692.3	<4				E _γ I _γ : as quoted by 1978En02.
	845.2 ¹	100	M1+E2	+0.15 ⁴		B(M1)(W.u.)=0.228 ¹⁷ ; B(E2)(W.u.)=21 ¹¹ . E _γ I _γ : as quoted by 1978En02.
855.65	383.1	26 ⁴	[E1]			B(E1)(W.u.)=9.2×10 ⁻⁵ 20.
	703.2	100 ⁴				
880.64	408.3	<5				E _γ I _γ : as quoted by 1978En02.
	728.7 ¹	100 ¹	M1+E2	-0.52 ⁷		B(M1)(W.u.)=0.0092 ²¹ ; B(E2)(W.u.)=13 ⁵ .
	880.5 ²	3.6 ²	[E1]			B(E1)(W.u.)=5.0×10 ⁻⁶ 20.
1158.76	278.1	36 ⁵	M1(+E2)	+0.2 ²		B(M1)(W.u.)=0.041 ¹² ; B(E2)(W.u.)<180.
	303.3	53 ¹⁶	M1(+E2)	+0.2 ²		B(M1)(W.u.)=0.047 ¹⁹ ; B(E2)(W.u.)<180.
	313.2	<6				
	686.4	4 ²	[E1]			B(E1)(W.u.)=8.×10 ⁻⁶ 5.
	1006.5	100 ⁴	M1+E2	-1.3 ⁺⁶⁻¹⁵		B(M1)(W.u.)=0.0009 ⁶ ; B(E2)(W.u.)=4.5 ¹⁹ .
1178.98	298.6 ^{‡&}	1				
	333.7	18 ³	[M1]			B(M1)(W.u.)=0.27 ¹² .
	706.9	100 ⁶	M1+E2	-0.18 ¹³		B(M1)(W.u.)=0.15 ⁷ ; B(E2)(W.u.)=30 ⁺⁵⁰⁻²⁸ .
	1178.9	22 ³	[E2]			B(E2)(W.u.)=15 ⁷ .
1337.53	456.73 ¹⁰	39.4 ¹⁵	M1+E2	-0.23 ⁴		I _γ : 26 ² in (p,γ) E=res seems discrepant and is not included in averaging. B(M1)(W.u.)=0.06 ³ ; B(E2)(W.u.)=46 ²⁴ . B(E2)(W.u.)=20 ⁹ . B(E1)(W.u.)=4.5×10 ⁻⁵ 19; B(M2)(W.u.)<3.
	1185.6 ¹	100 ²	E2			B(M1)(W.u.)=0.09 ³ .
	1338.0 ¹	26.9 ¹³	E1+M2	-0.10 ⁸		B(E2)(W.u.)=24 ⁹ .
1408.09	562.9 ²	17.1 ¹²	[M1]			B(M1)(W.u.)=0.033 ¹¹ ; B(E2)(W.u.)=1.1 ⁸ .
	936.0 ⁸	6.3 ¹¹	[E2]			B(M1)(W.u.)=0.19 ⁴ .
	1408.06 ¹²	100 ²	M1+E2	+0.15 ⁵		
1651.22	492.4	32 ⁴	M1(+E2)	0.0 ²		
	770.5	12 ³				

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued) $\gamma(^{43}\text{Sc})$ (continued)

E(level)	$E\gamma^{\dagger}$	$I\gamma^{\S}$	Mult. # $^{\circ}$	δ°	α	Comments
1651.22	795.7	5.4 20	[E2]			B(E2)(W.u.)=34 14.
	1498.9	100 5	M1 (+E2)	-0.05 18		B(M1)(W.u.)=0.021 4; B(E2)(W.u.)<0.6.
	1650.8	25 4	[E1]			B(E1)(W.u.)=9.8 $\times 10^{-5}$ 23.
1811.1	631.8	100 7	M1+E2	-0.22 7		B(M1)(W.u.)=2.1 8.
						B(E2)(W.u.)=720 +1230-470 as compared to RUL(E2)=300 suggests $\delta(E2/M1)\leq 0.15$.
	955.6	41 10	[E1]			B(E1)(W.u.)=0.006 3.
	1338.7	85 7	M1+E2	-0.22 7		B(M1)(W.u.)=0.18 8; B(E2)(W.u.)=14 11.
	1658.8	26 8	[E1]			B(E1)(W.u.)=0.0008 4.
1830.33	1830.10 13	100	E2			B(E2)(W.u.)=15.4 24.
1882.8	1002.3 $\frac{1}{2}^{\pm}$ &	21				
	1038.4 $\frac{1}{2}^{\pm}$ &	<5				I γ : from (α ,p γ), I γ =16 in (p, γ).
	1730 $\frac{1}{2}^{\pm}$ &					
	1882.5 3	100 14	M1+E2	-0.19 2		δ : for J=9/2, +0.42 3 for J=5/2 in (α ,p γ).
1932.55	595.1 1	37.5 10	M1+E2	-0.19 4		B(M1)(W.u.)=0.07 4; B(E2)(W.u.)=2.2 12.
						I γ : 19 2 in (p, γ) E=res seems discrepant and is not included in averaging.
						B(M1)(W.u.)=0.011 3; B(E2)(W.u.)=3.3 16.
	1051.9 1	100 3	E2			B(E2)(W.u.)=15 4.
	1931.4 $\frac{1}{2}^{\pm}$ &	1				
1962.89	784.0	15 2	M1 (+E2)	-0.04 25		B(M1)(W.u.)=0.082 18; B(E2)(W.u.)<0.8.
	804.5	4 1	[E1]			B(E1)(W.u.)=0.00051 15.
	1490.2 2	100 2	M1+E2	+0.21 6		B(M1)(W.u.)=0.077 13; B(E2)(W.u.)=4.4 25.
	1962.5 $\frac{1}{2}^{\pm}$ &					
2094.8	915.4	100 9	M1 (+E2)	0.00 10		B(M1)(W.u.)=0.033 10.
						I γ : from (p, γ):E=res, also for other γ transitions from the same level.
	1214.0 $\frac{1}{2}^{\pm}$	30 6	[E1]			B(E1)(W.u.)=0.00011 4.
	1239.2	55 6	[E1]			B(E1)(W.u.)=0.00018 6.
	1249.1 $\frac{1}{2}^{\pm}$	33 6				E γ : Seen also in (α ,p γ), but the placement is uncertain.
	1622.3	33 9				
	1942.4	54 9	[E1]			B(E1)(W.u.)=4.6 $\times 10^{-5}$ 15.
2106.6	455.4 $\frac{1}{2}^{\pm}$ &	17 9				
	947.6	33 8				
	1225.7	100 6				
	1954.1 $\frac{1}{2}^{\pm}$ &	10				
2114.5	955.9 $\frac{1}{2}^{\pm}$	79 9				
	1962.4 $\frac{1}{2}^{\pm}$	100 13				
2142.0	490.9 $\frac{1}{2}^{\pm}$	38				I γ : from (p, γ):E=res, also for other γ transitions from the same level.
	962.8 $\frac{1}{2}^{\pm}$	6 3				
	983.3	15 6				
	1261.4	100 9	(D+Q)	+0.27 10		
	1286.6 $\frac{1}{2}^{\pm}$	12 6				
	1669.7	42 8				
	1989.8	74 6				I γ : from $^{42}\text{Ca}(p,\gamma)$ E=Res. Other: 29 6 from $^{40}\text{Ca}(\alpha,p\gamma)$. Unweighted average is 52 22.
	2141.6	18 7	D (+Q)	0.00 4		
2242.8	1397.4	44				
	1770.6	100				
	2242.5	32				
2288.65	880.7 5	1.1 2				
	1443.5 3	1.3 3				
	1815.4 4	0.9 5				
	2137.1 1	2.1 4	[E1]			B(E1)(W.u.)>5.4 $\times 10^{-5}$.
	2288.3 1	100 4	M1+E2	+0.08 5		B(M1)(W.u.)>0.082.
2335.47	2335.4 1	100	M1 (+E2)	+0.08 5		B(M1)(W.u.)=0.06 3; B(E2)(W.u.)<0.5.
2383.1	731.9	100				
	1527.6	45	(M1+E2)	+0.49 7		B(M1)(W.u.)<0.0053; B(E2)(W.u.)<1.8.
2458.68	2458.6 1	100	M1 (+E2)	+0.15 7		δ : for J=5/2, -0.02 5 for J=9/2.
						B(M1)(W.u.)=0.038 14; B(E2)(W.u.)<0.8.
2553.54	620.35 15	100 3	(M1)			B(M1)(W.u.)=0.103 15.

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Adopted Levels, Gammas (continued)

 $\gamma(^{43}\text{Sc})$ (continued)

E(level)	$E\gamma^{\dagger}$	$I\gamma^{\S}$	Mult. #@	$\delta^@$	α	Comments
2553.54	1216.07 12	76 3	(E2)			B(E2)(W.u.)=20 3.
2580.8	1421.6	52 10				
	1699.7	40 8				
	2428.0	100 13				
2635.35	804.4 3	34 3	(M1)			B(M1)(W.u.)=0.031 11.
	1227.1 3	89 7	[E2]			B(E2)(W.u.)=43 16.
	2636.0 3	100 15	[E2]			B(E2)(W.u.)=1.1 4.
2650.5	1806.6					
2670.5	1491.4 $\frac{1}{2}^{\pm}$	16 4				
	1790.0 $\frac{1}{2}^{\pm}$	43 8				
	1815.2	100 4				
	2198.2	45 6				
2760.10	2760.0 1	100				
2795.4	1387.2	36				
	1950.0	87				
	2643.8 $\frac{1}{2}^{\pm}\&$	29				
	2795.1	100				
2811.1	704.7	76 9				
	1473.9	100 11				
	2810.6	70 30				
2840.7	457.3	41				
	1503.2	100				
	1959.7 $\frac{1}{2}^{\pm}\&$	37				
	2839.9	86				
2846.2	2846.1	100				
2860.8	1210.2	14 5				
	1682.1 $\frac{1}{2}^{\pm}$	16 5				
	1702.6 $\frac{1}{2}^{\pm}$	23 7				
	1980.7	100 5				
	2709.0	75 7				
2874.7	2723 $\frac{1}{2}^{\pm}$					
2985.0	1648.1 $\&$					$I\gamma$: 84 in ($\alpha, p\gamma$) but this branch is either absent (see 1977Di17) in (p, γ) or at the most $I\gamma=16$.
	1806.0 $\frac{1}{2}^{\pm}$	34 8				
	2104.5	71 5				
	2139.6	58 8				
	2832.9	100 8				
2988.12	1157.5 1	100	E2			B(E2)(W.u.)=5.4 7.
3123.73	135.6 1	100	E2		0.0934	B(E2)(W.u.)=2.67 2.
3142.05	588.2 1	9.4 3	(M1+E2)			B(M1)(W.u.)<0.017.
	1209.8 1	100 3	E2			B(E2)(W.u.)<41.
3159.3	2278.4	50				
	3006.8	88				
	3158.7	100				
3198.2	2725.5	100				
3260.1	1432 $\&$	4.2				$E\gamma$: from ($\alpha, p\gamma$) only.
	3259.6 10	100				
3292.4	1360.6 4	90				$E\gamma$: seen only in ($\alpha, p\gamma$).
	1479.9 $\frac{1}{2}^{\pm}\&$	21 5				
	2113.9	100 12				
	2412.5	21 7				
	2447.6	91 9				
3326.8	3327.1 $\frac{1}{2}^{\pm}$					
3332.2	1369 $\frac{1}{2}^{\pm}$	4 2				
	1521 $\frac{1}{2}^{\pm}$	13 4				
	2153	100 4				
	2174 $\frac{1}{2}^{\pm}$	44 4				
	2487	29 6				
	2860	19 4				
	3334					$E\gamma$: seen only in ($\alpha, p\gamma$).
3375.3	1492.6	53				
	1545.3	63				
	1967.2	100				

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Adopted Levels, Gammas (continued)

 $\gamma(^{43}\text{Sc})$ (continued)

E(level)	E $\gamma^{\dagger}$	I $\gamma^{\S}$	Mult. #@	$\delta^@$	Comments
3375.3	2038.3	40	[E1]		B(E1)(W.u.)>0.00013.
	3375.1	77			
3452.1	1640.8&	270			γ from (α ,p γ) only.
	2571.1	100 7			
	2606.2	45 7			
	3299.9 $\frac{1}{2}$	55 7			
	3451.3 $\frac{1}{2}$	27 9			
3463.3	2582.9 $\frac{1}{2}$	37 4			
	3311.3	100 7			
3503.2	2658 $\frac{1}{2}$	100 10			
	3503 $\frac{1}{2}$	100 10			
3631.7	3631.5 10	100			
3645.6	1682.5	34 11			
	1994.5	66 13			
	2466.4	100 16			
	2765.0	63 13			
3683.2	2803	25 4			
	2838	56 6			
	3531	100 7			
3734.0	1445.5	31			
	2325.7	83			
	2888.5	100			
3755.43	614.1 6	100 3	M1+E2	-0.11 8	
	766.9 2	3.00 14	D		
	1202.4 3	18.9 6	Q		
3756.5	3605	100 10			
	3757	43 7			
3807.2	2469.7	24 6			
	2926.2	100 5			
	3334.5	35 8			
3843.0	2998				
3860.1	3708				
3959.87	971.5 1	14.8 6	D		
	1324.5 1	17.2 7	Q		
	2129.7 1	100 3	Q		
4007.3	3126	83 20			
	3152	100 20			
	3535	50 13			
	3855	100 17			
4038.8	2107	100 13			
	3566	67 15			
4158.6	1605	100			
4301.2	2368.6 5	100			
4371.5	2265	37 7			
	2720	32 10			
	2963	49 12			
	3034	100 10			
	3491	27 7			
4383.03	1258.8 9	100	D+Q		E γ : γ not seen in $^{24}\text{Mg}(^{24}\text{Mg},\alpha\gamma)$ and $^{28}\text{Si}(^{20}\text{Ne},\alpha\gamma)$ (2007Ch40) due to this transition feeding 470-ns isomer.
	1394.9 2	24	D		
4430.2	3251	100 15			
	3271	75 13			
	3550	75 10			
4455.3	4455	100	D+Q		
4633.6	1509.8 19	100	D+Q		
5231.33	1475.5 6	100	D+Q		
5519.00	287.9 1	2.34 9	(M1)		B(M1)(W.u.)>0.26.
	1763.3 1	27.9 11	E2		B(E2)(W.u.)>13.
	2394.86 12	100	(E1)		B(E1)(W.u.)>0.00050.
5793.51	1833.6 2	100			
5919.4	2629	33			
	3249	33			

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Adopted Levels, Gammas (continued)
 $\gamma(^{43}\text{Sc})$ (continued)

E(level)	$E\gamma^{\dagger}$	$I\gamma^{\S}$	Mult. #@	$\delta^@$	Comments
5919.4	3338	33			
	3536	67			
	4268	67			
	4740	33			
	4760	67			
	5038	67			
	5074	100			
	5446	67			
	5767	100			
5950.5	2619	62			
	2660	19			
	3369	14			
	3615	5			
	3661	5			
	3808	10			
	3836	5			
	3856	10			
	3987	33			
	4139	5			
	4299	67			
	4771	100			
	4791	14			
	5094	43			
	5105&				
	5477	43			
	5798	43			
6060.5	6060				
6067.23	2107.3 1	100 3	E2		B(E2)(W.u.)=21 5.
	3079.0 1	30.5 10	E2		B(E2)(W.u.)=0.97 22.
6103.2	2260	1.6			
	2651	10			
	2943	1.6			
	3116	1.6			
	3257	1.6			
	3262	<1.6			
	3961	13			
	3996	5			
	4695	5			
	4766	8			
	4924	3			
	5247	1.6			
	5258	3			
	5630	1.6			
	5951	100			
	6103	5			
6136.2	3150&	30			
	3466&	15			
	3555	35			
	3994	24			
	4041	71			
	4173	100			
	4485	35			
	4957	65			
	4977	53			
	5255	41			
	5280	18			
	5291	24			
	5663	24			
	5984	100			
6143.4	2336	21			
	2853	21			
	3156	37			
	3473	32			

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Adopted Levels, Gammas (continued) $\gamma(^{43}\text{Sc})$ (continued)

E(level)	$E\gamma^{\dagger}$	$I\gamma^{\S}$	Mult. #@	$\delta^@$	Comments
6143.4	4048	32			
	4180	26			
	4332	11			
	4964	68			
	4984	16			
	5262	11			
	5287	100			
	5298	53			
	5670	16			
	5991	74			
	6143	11			
6172.98	653.9 2	56 5			
	941.4 1	94 4			
	2418.3 2	100 5			
	3048.6 8	33 8			
6184.2	6032				
6198.1	2464	16			
	3862	20			
	4056	16			
	4103	52			
	4235	12			
	4547	48			
	5317	100			
	5342	60			
	5353	12			
	6046	64			
6217.4	2357	2			
	2572	6			
	2765	6			
	3230	8			
	3357	12			
	3547	10			
	4075	4			
	4110	2			
	4122	4			
	4406	6			
	4809	2			
	4880	<2			
	5336	6			
	5361	100			
	5744	16			
	6065	8			
	6217	8			
6247.2	4105	50			
	4152	17			
	4284	33			
	5068	17			
	5366	33			
	5402	83			
	6095	100			
6283.49	764.3 1	24.2 20	(M1)		B(M1)(W.u.)=0.07 3.
	1052.9 4	1.3 10	[E2]		B(E2)(W.u.)=8 4.
	1648&	39			$E\gamma$: reported as tentative γ only in $^{27}\text{Al}(^{19}\text{F}, p2n\gamma)$.
	3159.8 2	100 5	(E1)		B(E1)(W.u.)= 9×10^{-5} 4.
6320.4	2513	11			
	2868	5			
	3333	11	D+Q	-0.02 4	
	3739	3			
	3937	2	D+Q	-0.18 8	
	4178	10	D+Q	+0.07 6	
	4669	2			
	4983	3			
	5141	6	D+Q	0.00 3	

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Adopted Levels, Gammas (continued) $\gamma(^{43}\text{Sc})$ (continued)

E(level)	$E\gamma^{\dagger}$	$I\gamma^{\S}$	Mult. #@	$\delta^@$	Comments
6320.4	5439	10	D+Q	+0.14 5	
	5464	10			$\delta(Q/D)=+0.01\ 3$ or $-3.1\ 5$.
	5475	8			
6431.04	6168	100	D+Q	+0.03 3	
	912.0 1	100 3			B(E2)(W.u.)=5.7 6.
	3307.4 4	8.7 3			B(M2)(W.u.)=0.031 4.
6685.1	4104	13	E2	[M2]	
	4590	79			
	4722	42			
	5506	38			
	5804	33			
	5829	25			
	6212	29			
	6533	100			
	3013	5			
	3369&	5			
6696.2	4313	9	D+Q	-0.47 8	$\delta(Q/D)=-0.13\ 10$ or $-4.2\ +10-15$ for $J\pi(2383)=7/2$ and $+0.20\ 10$ for $J\pi(2383)=3/2$.
	4733	5			
	5044	11			
	5359	11			$\delta(Q/D)=-0.14\ 6$ or $-23\ +\infty-12$.
	5517	7			
	5537	7			
	5815	32			
	5851	7			
	6223	2			
	6544	100			
	6695	27			
	6777.3	64			
	3790	45			
	4196	55			
	4394	36			
6777.3	4635	82	D+Q	+0.03 3	
	5125	91			
	5369	18			
	5440	27			
	5598	100			
	5896	91			
	5921	45			
	5932	82			
	6304	91			
	6625	82			
	3691.0 18	100			
	6814.5	100 5			
	645.4 1	100 5			
	1586.9 3	29 3			
	6918.6	3			
6918.6	3076	3	D+Q	-0.04 4	
	3592	6			
	3658	6			
	4044	3			
	4123	3			
	5034	5			
	5511	5			
	6037	3			
	6074	100			
	6917	11			
7106.88	288.4 1	8.0 4	D	0.00 2	
	675.9 1	100 4			
	823.3 1	69 3			
	933.0 5	12.6 8			
7118.8	3362.2 10	100	D+Q	-0.29 8	
7273.5	3516.9 5	100			
7344.1	3484	13			
	3537	39			

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)
 $\gamma(^{43}\text{Sc})$ (continued)

E(level)	E $\gamma^{\dagger}$	I $\gamma^{\S}$	Mult. # $^{\@}$	$\delta^{\@}$	Comments
7344.1	3661	10			
	3698	10			
	4184	19			
	5229	6			
	5692	19			
	6007	6			
	6165	6			
	6185	6			
	6463	100			
	7191	55			
	7343	32			
7359.16	252.3 1	2.84 16	[M1]		B(M1)(W.u.)=0.109 11.
	928.2 1	100 3	M1 (+E2)	-0.1 1	B(M1)(W.u.)=0.078 6.
	1075.6 3	0.85 10	[E2]		B(E2)(W.u.)=1.00 15.
7394.18	2964	20			
	3387	28			
	3637	8			
	3931	12			
	3942	12			
	4519	8			
	4534	8			
	4598	4			
	4813	4			
	5011	4			
	5252	4			
	5279	28			
	5583	8			
	5742	8			
	5986	4			
	6057	4			
	6215	16			
	6235	40			
	6513	32			
	6538	20			
	6548	16			
	6921	8			
	7241	100			
	7393	4			
7512.3	3141	12			
	3474	3			
	3705	10			
	4671	3			
	4701	3			
	4960	3			
	5580	100			
	5627	3			
	6353	5			
	6666	3			
	7511	22			
7581.4	3151	3			
	3898	18			
	4078	5			
	4129	8			
	4207	5			
	4721	3			
	5439	13			
	6700	100			
	7428	93			
8010.1	2491.0 3	100			
	8434.37	9.9 12			E γ : poor fit in the level scheme. Level-energy difference=2367.1.
	5310.5 1	100 7	Q		

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)
 $\gamma(^{43}\text{Sc})$ (continued)

E(level)	E $\gamma^{\dagger}$	I $\gamma^{\S}$	Mult. # @	Comments
8555.56	2488.2 1	100	Q	
8703.06	1595.2 3	11.3 6		
	2271.8 2	100 4	D	
8831.84	1472.5 1	100 3	(M1)	B(M1)(W.u.)=0.089 19.
	1724.8 2	5.0 9	[E2]	B(E2)(W.u.)=2.7 8.
9218.8	3151.4 3	100	(D)	
9578.86	2219.2 2	70 17		
	3147.7 2	100 4		
9995.10	1439.5 1	100 4	D	
	2887.4 6	39 9		
10084.47	1381.2 1	35 4	D	
	1529.0 1	49 6	Q	
	1650.3 1	100 4	Q	
	2725.6 2	21 5	D	
10178.6	3071.6 5	100		
10436.84	3329.9 2	100		
10613.21	2177.8 6	4.4 6	Q	
	3253.9 1	100 4	D	
10856.18	771.6 4	10.3 12		
	860.4 2	12.2 20	D	
	3497.0 1	100 4	D	
11252.0	3892.6 3	100		
11355.60	2799.5 2	100 4	Q	
	2920.2 10	12.7 22		
	3997.1 3	49 4		
11661.0	3105.3 4	100		
11807.36	951.0 3	19.7 10	D	
	2228.0 2	28.5 19		
	2975.2 1	100 3	D	
11920.54	4560.5 3	66 6	D	
	5489.0 3	100 4	D	
12053.33	1968.8 1	100 4	D	
	2058.7 2	25 6		
12073.15	1460.1 1	100	D	
12614.84	1757.9 7	14.1 8		
	2530.6 1	100 3	Q	
12703.9	4148.1 8	100		
12804.39	2190.8 3	56 12		
	3972.5 2	100 4		
13044.65	2607.8 2	61 3		
	4213.0 3	100 4	D	
	4341.7 3	81 8		
	5684.9 4	83 4		
13116.57	1043.6 1	32.3 16	D	
	2503.1 1	100 4	Q	
13122.7	3038.1 5	100		
13584.1	4752.0 3	100	D	
14405.80	1289.2 3	7.9 7		
	1791.2 1	100 4	D	
	2353.2 3	26.9 17	Q	
	2598.0 1	48.2 18	(Q)	
14451.1	2530.4 1	100 4		
	2644.5 5	38 9		
	5620.1 5	58 13		
14561.2	2508.0 3	61 19		
	3205.3 3	100 4	Q	
14914.3	6081.0 3	100	Q	
15910.7	2866.3 2	100 5		
	3296.0 4	35.2 20		
16703.6	3586.9 5	100		
16708.4	3124.2 3	100		
16711.2	3906.6 5	100		
17767.4	2852.9 1	100	(Q)	

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)
 $\gamma(^{43}\text{Sc})$ (continued)

E(level)	$E\gamma^\dagger$	$I\gamma^\S$	Mult. # [@]
17921.1	3469.8 2	100	(D)
18196.8	3635.4 3	100	Q
18765.3	997.9 1	100	D
19208.6	1440.7 2	59 10	
	3298.8 3	100 5	

[†] Values with ΔE are primarily from ⁴³Ti ϵ decay, (¹⁶O,pn γ), (¹⁹F,p2n γ), (²⁰Ne, α p γ) and (²⁴Mg, α p γ). Weighted averages are taken when available. Others are from level-energy differences.

[‡] γ seen in (p, γ) only.

[§] Weighted average of all available γ -ray data, unless otherwise noted. In some cases unweighted averages are taken when values from two or more reactions are very different, and there does not seem a preference for any one value.

From $\gamma(\theta)$, $\gamma(\text{lin pol})$ or $\gamma\gamma(\theta)$ data in (p, γ), (α ,p γ), (¹⁶O,pn γ), (¹⁹F,p2n γ), (²⁰Ne, α p γ) and (²⁴Mg, α p γ).

@ Primarily from (α ,p γ), (p, γ), (¹⁶O,pn γ), (¹⁹F,p2n γ). For δ , weighted average is taken when data from different reactions are available. If $T_{1/2}$ is unknown and parity is determined not by polarization measurements, evaluators use D and Q, instead of M1 and E2, or, E1 and M2.

& Placement of transition in the level scheme is uncertain.

⁴³Ti ϵ Decay (509 ms) 1987Ho14

Parent ⁴³Ti: E=0; $J\pi=7/2^-$; $T_{1/2}=509$ ms 5; Q(g.s.)=6867 7; % ϵ +% β^+ decay=100.

⁴³Ti-J,T_{1/2}: From Adopted Levels of ⁴³Ti.

⁴³Ti-Q(ϵ): From 2012Wa38.

1987Ho14: ⁴³Ti nuclides were produced by the ⁴⁰Ca(α ,n) reaction with an 18 MeV alpha beam from the MC-20 cyclotron of the University of Jyväskylä. β -rays were detected by a 500 μm , 300 mm² Si(Au) surface-barrier detector and γ -rays by a 15.5% Ge detector. Measured $E\gamma$, $I\gamma$, E(β). Deduced levels, β^- and γ -branchings, $T_{1/2}$. Comparison with shell-model calculations.

Others:

$T_{1/2}$ and isotopic identification: 1967Al08, 1963Va37, 1961Ja22 (also 1960Ja12), 1954Ty33, 1948Sc20.

β^+ : 1969Va41 (also 1963Va37), 1961Ja22.

γ : 1971BIZH.

⁴³Sc Levels

E(level) [†]	$J\pi^\ddagger$	Comments
0.0	7/2-	
151.25 14	3/2+	
472.7 § 3	3/2-	
845.17 9	5/2-	
1408.03 9	7/2-	
1882.5 3	(5/2, 9/2)-	
1963.0 4	(3/2, 5/2)-	$J\pi$: log $ft=6.35$ 20 from 7/2- parent state disfavors 3/2, but the level is weakly populated and this argument is not strong enough to reject 3/2 which is supported by L-transfers in other experiments
2288.40 10	5/2-	
2335.47 10	5/2-	
2458.68 10	(5/2 to 9/2)-	
2760.10 10	(5/2 to 9/2)-	
3259.7 10	(7/2, 9/2)-	
3631.7? 10	(5/2-, 7/2-, 9/2-)	

[†] From least-squares fit to $E\gamma$ data.

[‡] From Adopted Levels.

[§] Intensity balance gives apparent β^+ feeding of 0.11% 6.

^{43}Ti ϵ Decay (509 ms) $^{1987}\text{Ho14}$ (continued) β^+, ϵ Data

There is an apparent β^+ feeding of 0.11% 6 to the 3/2- at 472.7 giving an unrealistic $\log ft=6.3$ for 7/2- to 3/2-. This imbalance is due either to missing γ transitions to the 472.7 level or to intensity problems in the γ -rays involved. Due to the large difference between the Q-value and the energy of highest populated level, this decay scheme seems incomplete.

E_ϵ	E(level)	$I\beta^{+\dagger}$	$I\epsilon^\dagger$	$\log ft$	$I(\epsilon+\beta^+)^\dagger$	Comments
(3235 $\frac{5}{2}^-$ 7)	3631.7?	0.016 4	0.00026 7	5.40 11	0.016 4	
(3607 7)	3259.7	0.011 2	0.00011 2	5.86 8	0.011 2	
(4107 7)	2760.10	0.20 3	0.0012 2	4.94 7	0.20 3	
(4408 7)	2458.68	0.91 13	0.0042 6	4.46 7	0.91 13	
(4532 7)	2335.47	0.38 6	0.0016 3	4.91 7	0.38 6	
(4579 7)	2288.40	4.6 7	0.018 3	3.85 7	4.6 7	
(4904 7)	1963.0	0.022 10	$7. \times 10^{-5}$ 3	6.35 20	0.022 10	
(4985 7)	1882.5	0.26 5	0.00075 15	5.32 9	0.26 5	
(5459 7)	1408.03	0.67 10	0.0014 2	5.13 7	0.67 10	
(6022 7)	845.17	2.6 4	0.0038 6	4.78 7	2.6 4	
(6716 $\frac{5}{2}^-$ 7)	151.25	<0.07	<0.0001	>8.5 ^{1u}	<0.07	
(6867 7)	0.0	90.2 14	0.0826 16	3.554 9	90.3 14	$I(\epsilon+\beta^+)$: 100-summed feeding to higher levels.

[†] Absolute intensity per 100 decays.

[‡] Existence of this branch is questionable.

 $\gamma(^{43}\text{Sc})$

I_γ normalization: $I_\gamma(845\gamma)$ (per 100 decays)=2.8 4, from comparison of γ -ray yield to the yield of 0.5-s component of $\gamma^\pm$ radiation (1987Ho14).

E_γ	E(level)	$I_\gamma^\S$	Mult. [†]	$\delta^\dagger$	E_γ	E(level)	$I_\gamma^\S$	Mult. [†]	$\delta^\dagger$
(151.9)	151.25	2.9 $\frac{5}{2}^-$ 12			1815.4 4	2288.40	0.9 5		
472.7 4	472.7	4.8 10			1882.5 3	1882.5	5.9 8		
562.9 2	1408.03	2.8 5			2137.1 1	2288.40	2.1 4		
845.2 1	845.17	62.9 19	M1+E2	+0.15 4	2288.3 1	2288.40	100 4	M1+E2	+0.08 5
880.7 5	2288.40	1.1 2			2335.4 1	2335.47	8.7 7		
936.0 8	1408.03	1.0 2			2458.6 1	2458.68	20.7 8		
1408.0 1	1408.03	12.6 4	M1+E2	+0.15 5	2760.0 1	2760.10	4.5 3		
1443.5 3	2288.40	1.3 3			3259.6 10	3259.7	0.24 4		
1490.2 2	1963.0	0.5 2	M1+E2	+0.21 6	3631.5 [#] 10	3631.7?	0.36 6		

[†] Multipolarities and mixing ratios from Adopted Gammas.

[‡] Estimated (evaluators) from $\log f^{lu}_t > 8.5$ and $I_\gamma(2137\gamma)$.

[§] For absolute intensity per 100 decays, multiply by 0.044 6.

[#] Placement of transition in the level scheme is uncertain.

⁴³Ti ε Decay (509 ms) 1987Ho14 (continued)

²⁴Mg(²⁴Mg,αpγ) 2007Ch40

2007Ch40: E=94 MeV beam from Berkeley 88-in cyclotron. Measured E_γ, I_γ, γγ, γ(θ), γγ(θ)(DCO) using Gammasphere with 102 Compton-suppressed HPGe detectors. Particles detected with an array of 95 CsI(Tl) detectors with a 65% efficiency for detection of α particles and 50% for protons.

A similar experiment was done by 2007Ch40 using the reaction ²⁸Si(²⁰Ne,αpγ). The γ-ray energies and angular distribution/ correlation coefficients are averages from the two experiments. These coefficients are listed only with this dataset.

⁴³Sc Levels

E(level) [†]	Jπ [§]	T _{1/2}	E(level) [†]	Jπ [§]	E(level) [†]	Jπ [§]
0.0 [#]	7/2-	438 μs [‡] 7	6431.60 ^a 13	23/2+	12053.72 16	29/2(-)
152.25 ^a 11	3/2+		6818.98 15	(21/2+)	12073.76 18	(29/2-)
845.42 20	5/2-		7107.43 ^{&} 13	23/2+	12615.45 16	(31/2)-
880.97 ^b 10	5/2+		7118.4 10		12704.2 10	
1337.85 ^a 9	7/2+		7273.1 10		12804.7 4	
1408.38 [@] 16	7/2-		7359.77 ^b 14	25/2+	13045.3 ^{&} 3	(29/2+)
1830.62 [#] 9	11/2-		8010.6 4		13117.20 18	(31/2-)
1932.83 ^b 10	9/2+		8434.56 17	23/2-	13123.1 6	
2554.07 ^a 10	11/2+		8555.89 [@] 14	23/2-	13584.6 11	(29/2+)
2635.72 [@] 12	11/2-		8703.53 15	25/2(+)	14406.61 17	(33/2-)
2988.74 [#] 11	15/2-	470 ns [‡] 4	8832.32 ^a 16	27/2+	14452.1 4	(29/2+)
3124.32 [#] 13	19/2-		9219.2 4	(21/2-)	14561.4 [@] 3	31/2-
3142.46 ^b 11	13/2+		9579.35 18	(27/2+)	14916.7 5	31/2
3293.5 5	7/2-		9995.34 16	25/2(-)	15911.6 ^{&} 3	(33/2+)
3756.04 ^a 11	15/2+		10084.85 14	27/2-	16704.3 11	
3960.31 [@] 11	15/2-		10179.1 6		16708.9 11	
4301.5 5			10437.43 ^{&} 22	(25/2+)	16711.5 11	
4383.67 23	17/2(-)		10613.82 17	(27/2-)	17769.8 5	(35/2)
5232.02 ^b 13	17/2+		10856.86 16	(27/2-)	17922.0 5	(31/2+)
5519.53 ^a 12	19/2+		11252.6 10	25/2+	18197.0 [@] 11	35/2-
5793.95 23			11355.67 [@] 22	27/2-	18767.7 5	(37/2)
6067.70 [@] 12	19/2-		11661.3 5		19210.5 ^{&} 4	(37/2+)
6173.53 ^{&} 14	19/2+		11807.67 17	29/2(-)		
6284.04 ^b 14	21/2+		11921.6 5	25/2(+)		

Footnotes continued on next page

²⁴Mg(²⁴Mg,α γ) 2007Ch40 (continued)

⁴³Sc Levels (continued)

† From least-squares fit to E γ data. The normalized $\chi^2=5.8$ for the uncertainties as quoted by 2007Ch40. This value is much larger than the critical $\chi^2=1.5$. The uncertainties of the following ten γ -rays were increased by a factor of 2 or 3 to get an acceptable fit with normalized $\chi^2=2.5$: 287.9, 860.4, 1157.5, 1595.2, 2177.8, 2369.6, 2418.3, 2598.0, 2725.6, 6081.0. It should be that the uncertainties for level energies quoted in Table V of 2007Ch40 are much larger than those given here.

‡ From Adopted Levels.

§ From 2007Ch40 based on multipolarities deduced from $\gamma(\theta)$ and $\gamma\gamma(\theta)$ (DCO) data, and band associations.

(A): γ sequence based on g.s.

@ (B): γ sequence based on 7/2-.

& (C): γ sequence based on 19/2+.

a (D): γ sequence based on 3/2+.

b (E): γ sequence based on 5/2+.

 $\gamma(^{43}\text{Sc})$

The DCO values are for $\approx 90^\circ$ (range of 69.8° – 110.2°) and forward/ backward angles (50.1° – 129.9° range). The gates are on $\Delta J=2$, quadrupole or $\Delta J=0$, dipole transitions, unless otherwise stated. Expected values for $\Delta J=1$, dipole gate are: 1.6 for $\Delta J=2$, quadrupole or $\Delta J=0$, dipole; 1.0 for $\Delta J=1$, dipole; 0.5 to 1.9 for $\Delta J=1$, dipole+quadrupole; 1.1 to 1.7 for $\Delta J=0$, dipole+quadrupole. Expected values for $\Delta J=2$, quadrupole gate are: 1.0 for $\Delta J=2$, quadrupole or $\Delta J=0$, dipole; 0.6 for $\Delta J=1$, dipole; 0.3 to 1.2 for $\Delta J=1$, dipole+quadrupole; 0.6 to 1.1 for $\Delta J=0$, dipole+quadrupole.

E γ [†]	E(level)	I γ	Mult. [‡]	Comments
135.5 1	3124.32	1.73 8		
252.3 1	7359.77	2.04 9		
287.9 § 1	5519.53	1.81 7	D	A ₂ =-0.43 12; A ₄ =+0.09 17.
288.4 1	7107.43	0.60 5		
456.7 1	1337.85	3.72 16		
562.9 2	1408.38	0.45 6		
588.2 1	3142.46	3.02 11		
595.1 1	1932.83	10.8 3		
613.5 1	3756.04	32.4 10	D	A ₂ =-0.42 8; A ₄ =+0.06 10.
621.3 1	2554.07	5.94 21	D	A ₂ =-0.43 8; A ₄ =-0.01 10.
645.4 1	6818.98	2.19 11		
653.9 2	6173.53	1.08 9		
675.9 1	7107.43	7.3 3	D	DCO=1.06 4; A ₂ =+0.54 7; A ₄ =+0.21 10.
728.7 1	880.97	49.1 16	D	A ₂ =-0.35 5; A ₄ =+0.13 6.
764.3 1	6284.04	2.23 15	D	DCO=0.70 23.
766.9 2	3756.04	0.91 7	D	DCO=0.73 12.
771.6 4	10856.86	0.42 9		
804.4 3	2635.72	0.76 10	D	DCO=0.49 14.
823.3 1	7107.43	4.86 20	D	DCO=0.60 15.
845.3 3	845.42	0.48 7		
860.4 # 2	10856.86	0.64 6	D	DCO=0.43 10.
880.5 2	880.97	1.95 12		
912.0 1	6431.60	100 3	Q	DCO=1.01 2; A ₂ =+0.37 3; A ₄ =+0.03 4.
928.2 1	7359.77	76.2 24	D	DCO=0.68 1; A ₂ =-0.18 3; A ₄ =+0.10 4.
933.0 5	7107.43	0.90 11		
941.4 1	6173.53	1.82 8		
951.0 3	11807.67	1.20 8	D	DCO=0.70 11.
971.5 1	3960.31	2.28 10	D	DCO=1.01 18.
997.9 1	18767.7	0.65 4	D	DCO=0.65 17.
1043.6 1	13117.20	0.95 17	D	DCO=0.64 15.
1051.9 1	1932.83	29.4 9	Q	A ₂ =+0.25 5; A ₄ =-0.07 7.
1052.9 4	6284.04	0.25 6		
1075.6 3	7359.77	0.56 8		
1157.5 # 1	2988.74	15.2 5	Q	DCO=1.05 5; A ₂ =+0.38 6; A ₄ =-0.02 8.
1185.6 1	1337.85	9.1 4	Q	A ₂ =+0.41 5; A ₄ =-0.08 7.
1202.1 1	3756.04	6.32 22		
1209.7 1	3142.46	31.0 10	Q	A ₂ =+0.27 3; A ₄ =+0.08 5.
1216.1 1	2554.07	4.60 20		
1227.1 3	2635.72	1.90 25		
1289.2 3	14406.61	0.44 7		
1324.5 1	3960.31	2.52 13	Q	DCO=0.96 10.
1338.0 1	1337.85	2.41 13	D	DCO=1.03 11.
1360.6 4	3293.5	0.52 10		

Continued on next page (footnotes at end of table)

$^{24}\text{Mg}(^{24}\text{Mg},\alpha\gamma)$ 2007Ch40 (continued)

 $\gamma(^{43}\text{Sc})$ (continued)

$E\gamma^{\dagger}$	E(level)	$I\gamma$	Mult. ‡	Comments
1381.2 1	10084.85	3.37 14	D	DCO=0.47 3.
1394.9 2	4383.67	1.43 11	D	DCO=0.54 5.
1408.3 2	1408.38	2.1 5	D	DCO=1.19 23.
1439.5 1	9995.34	2.02 11	D	DCO=0.66 4.
1440.7 2	19210.5	0.75 4		
1460.1 1	12073.76	2.26 14	D&	DCO=1.05 15.
1472.5 1	8832.32	36.1 11	D	DCO=0.73 3; $A_2=-0.15$ 3; $A_4=+0.10$ 4.
1476.0 1	5232.02	5.54 21		
1529.0 1	10084.85	4.57 18	Q	DCO=1.19 8.
1586.9 3	6818.98	0.64 6		
1595.2§ 3	8703.53	0.95 9		
1650.3 1	10084.85	8.3 3	Q	DCO=0.94 7; $A_2=+0.33$ 6; $A_4=+0.06$ 8.
1724.8 2	8832.32	1.47 11		
1757.9 7	12615.45	1.62 11		
1763.3 1	5519.53	23.0 7	Q	$A_2=+0.50$ 10; $A_4=-0.04$ 10.
1791.2 1	14406.61	4.80 20	D	DCO=0.47 7; $A_2=-0.52$ 13; $A_4=-0.17$ 18.
1830.5 1	1830.62	37.7 24	Q	DCO=1.04 3; $A_2=+0.36$ 3; $A_4=-0.01$ 4.
1833.6 2	5793.95	1.90 18		
1968.8 1	12053.72	4.89 24	D	DCO=0.92 12; $A_2=-0.14$ 9; $A_4=+0.06$ 12.
2058.7 2	12053.72	1.51 9		
2107.3 1	6067.70	15.1 5	Q	DCO=0.96 3; $A_2=+0.37$ 4; $A_4=-0.08$ 6.
2129.7 1	3960.31	14.5 5	Q	DCO=1.03 4; $A_2=+0.32$ 4; $A_4=-0.14$ 5.
2177.8§ 6	10613.82	0.32 6	Q@	DCO=1.1 4.
2190.8 3	12804.7	0.60 6		
2219.2 2	9579.35	1.28 11		
2228.0 2	11807.67	1.78 11		
2271.8 1	8703.53	8.0 3	D	DCO=0.54 5; $A_2=-0.31$ 16; $A_4=-0.22$ 21.
2353.2 3	14406.61	1.42 10	Q@	DCO=1.0 4.
2368.6 5	4301.5	0.54 9		
2369.6# 4	8434.56	1.26 9		
2394.9 1	5519.53	79.4 25	D	DCO=1.02 1; $A_2=+0.40$ 1; $A_4=+0.01$ 2.
2418.3§ 2	6173.53	1.93 10		
2488.2 1	8555.89	13.3 4	Q	DCO=1.14 7; $A_2=+0.15$ 5; $A_4=-0.18$ 7.
2491.0 3	8010.6	2.17 18		
2503.1 1	13117.20	3.00 14	Q&	DCO=1.73 20.
2508.0 3	14561.4	0.71 9		
2530.4 1	14452.1	2.45 12		
2530.6 1	12615.45	10.6 4	Q	DCO=1.3 3; $A_2=+0.18$ 6; $A_4=-0.33$ 8.
2598.0# 1	14406.61	2.33 11	(Q)	$A_2=+0.41$ 24; $A_4=+0.4$ 3.
2607.8 2	13045.3	1.11 6		
2636.0 3	2635.72	2.3 4		
2644.5 5	14452.1	1.23 8		
2725.6§ 2	10084.85	2.36 11	D	DCO=0.68 14.
2799.5 2	11355.67	2.53 12	Q	DCO=0.99 10.
2852.9 1	17769.8	2.57 11	(Q)	$A_2=+0.10$ 18; $A_4=-0.4$ 3.
2866.3 2	15911.6	2.89 13		
2887.4 6	9995.34	1.10 9		
2920.2 10	11355.67	0.25 6		
2975.2 1	11807.67	5.66 20	D@	DCO=0.71 5; $A_2=-0.35$ 12; $A_4=+0.10$ 16.
3038.1 5	13123.1	1.04 10		
3048.6 8	6173.53	0.63 15		
3071.6 5	10179.1	0.57 8		
3079.0 1	6067.70	4.76 18	Q	DCO=1.07 5; $A_2=+0.16$ 6; $A_4=-0.27$ 8.
3105.3 4	11661.3	0.58 5		
3124.2 3	16708.9	0.64 5		
3147.7 2	9579.35	2.43 15		
3151.4 3	9219.2	1.62 9	(D)@	DCO=1.14 15.
3159.8 2	6284.04	8.2 8	D&	DCO=0.91 8.
3205.3 3	14561.4	1.69 11	Q@	DCO=1.11 16.
3253.9 1	10613.82	8.2 3	D	DCO=0.55 3; $A_2=-0.15$ 4; $A_4=-0.08$ 6.
3296.0 4	15911.6	1.01 7		
3298.8 3	19210.5	1.09 7		
3307.6 2	6431.60	8.5 3	[M2]	

Continued on next page (footnotes at end of table)

$^{24}\text{Mg}(^{24}\text{Mg},\alpha\gamma)$ 2007Ch40 (continued) $\gamma(^{43}\text{Sc})$ (continued)

$E\gamma^\dagger$	E(level)	I_γ	Mult. ‡	Comments
3329.9 2	10437.43	1.71 10		
3362.2 10	7118.4	0.26 7		
3469.8 2	17922.0	1.70 9	(D)	DCO=0.77 10.
3497.0 1	10856.86	4.54 18	D	DCO=0.59 6; $A_2=-0.04$ 6; $A_4=-0.03$ 8.
3516.9 5	7273.1	0.48 5		
3586.9 5	16704.3	0.54 6		
3635.4 3	18197.0	0.98 6	Q [@]	DCO=1.2 3.
3892.6 3	11252.6	2.67 13		
3906.6 5	16711.5	0.76 6		
3972.5 2	12804.7	1.37 7		
3997.1 3	11355.67	1.34 8		
4148.1 8	12704.2	0.16 3		
4213.0 3	13045.3	1.71 8	D [@]	DCO=0.76 17.
4341.7 3	13045.3	1.25 7		
4560.5 3	11921.6	1.76 8	D	DCO=1.02 8.
4752.0 3	13584.6	1.23 7	D [@]	DCO=0.48 9; $A_2=-0.28$ 21; $A_4=+0.2$ 3.
5310.5 1	8434.56	10.7 12	Q [@]	DCO=1.42 22; $A_2=+0.19$ 9; $A_4=-0.08$ 12.
5489.0 3	11921.6	2.43 11	D	DCO=0.84 11.
5620.1 5	14452.1	1.82 8		
5684.9 4	13045.3	1.47 8		
6081.0 § 3	14916.7	4.05 14	Q	DCO=1.19 12; $A_2=+0.44$ 5; $A_4=-0.21$ 7.

[†] The quoted uncertainties are statistical only. Above 3.5 MeV (maximum range of calibration curve), systematic uncertainties can be 1–2 keV.

[‡] 2007Ch40 assign multiplicities for most of the transitions, many based only on $J\pi$ assignments. The evaluators assign mult=D for $\Delta J=0,1$ M1 or E1 and Q for $\Delta J=2$, Q transitions for which supporting angular distribution/correlation data are available. Dipole transitions with expected M1 character may include E2 component.

§ Poor fit in the level scheme. The uncertainty is increased by a factor of 2 for fitting purposes.

Poor fit in the level scheme. The uncertainty is increased by a factor of 3 for fitting purposes.

@ DCO value corresponds to an alternative DCO-like analysis (1989Kr01).

& DCO value corresponds to gate on $\Delta J=1$, stretched dipole transition.

 $^{27}\text{Al}(^{18}\text{O},2n\gamma)$ 2008Fe02

2008Fe02: E=75 MeV beam provided by Tandem accelerator at IPN Orsay. Measured γ -rays with one clover and three single Ge detectors with BGO Compton suppression. Lifetime of isomer measured by $\gamma(t)$ as a side measurement (for confirmation purposes of main measurements for ^{139}Nd and ^{140}Nd) as the ^{18}O beam was hitting the target frame made of aluminum.

 ^{43}Sc Levels

E(level)	$J\pi^\dagger$	$T_{1/2}$
0.0	7/2-	
1830	11/2-	
2988	15/2-	
3124	19/2-	481 ns ‡ 9

[†] From Adopted Levels.

[‡] From $\gamma(t)$ (2008Fe02).

 $\gamma(^{43}\text{Sc})$

$E\gamma$	E(level)
136	3124
1158	2988
1830	1830

²⁷Al(¹⁹F,p2n γ) 2004Mo47,1976Po03

2004Mo47: E=50 MeV beam was produced from the tandem accelerator at the Japan Atomic Energy Research Institute (JAERI). Target of a 0.92 mg/cm² ²⁷Al foil on 10 mg/cm² natural Pb backing. γ -rays were detected by the GEMINI-II array of 16 HPGe detectors with BGO anti-Compton shields. Measured E γ , I γ , $\gamma\gamma$, $\gamma(\theta)$. Deduced levels J, π . Comparison with shell-model predictions.

1976Po03: E=40 MeV ¹⁹F beam was produced at the Brookhaven National Laboratory. Target of aluminum evaporated onto a tungsten backing. γ -rays were detected by Ge(Li) detectors. Measured E γ , I γ , $\gamma\gamma$, $\gamma(\theta)$, $\gamma(\text{lin pol})$. Deduced levels, T_{1/2} by recoil distance method.

1981Da06: E=45.5 MeV. Measured $\gamma\gamma(\theta, t)$, deduced Q of the 19/2- isomer at 3123.

1994Zh43: E=50.06 MeV. Measured isomer g factor by $\gamma(\theta, H, t)$ method.

⁴³Sc Levels

E(level) [†]	J π [‡]	T _{1/2} [#]	Comments
0.0 ^b	7/2- [§]		
151.65 ^a 17	3/2+ [§]		
472.50 20	3/2-	161 ps ^{&} 37	
880.24 ^a 22	5/2+	4.9 ps ^{&} 10	
1337.00 ^a 24	7/2+		
1829.9 ^b 3	11/2-		
1931.8 ^a 4	9/2+		
2552.6 ^a 4	11/2+		
2987.5 ^b 3	15/2-		
3123.4 ^b 4	19/2-	469 ns [@] 4	Q=0.199 14 (1981Da06). Q: time differential perturbed angular distribution method. g=0.3279 19 (1994Zh43).
3140.8 ^a 4	13/2+		
3755.4 ^a 4	15/2+		
4382.2 8	(17/2-)	40 fs 17	
4633.2 20	(17/2-, 21/2-)	<110 fs	
5230.3 ^a 5	(17/2+)		
5517.9 ^a 4	(19/2+)		
6065.5 16	(11/2, 15/2, 19/2)	55 fs 12	
6281.4 10	(17/2, 21/2)	110 fs 38	
6429.4 ^a 6	(23/2+)		
6814.5 19		94 fs 20	
7105.1 8	(21/2+, 25/2+)		
7356.4 ^a 12	(25/2+)	340 fs 21	
8699.5 12	(21/2+, 25/2+)		
8828.4 ^a 16	(27/2+)	74 fs 15	

[†] From least-squares fit to E γ data.

[‡] From $\gamma(\theta)$ and $\gamma(\text{lin pol})$ of 2004Mo47 and 1976Po03.

[§] From Adopted Levels.

[#] From DSAM, values are from e-mail reply of Dec 9, 2004 to B. Singh from the first author of 2004Mo47.

[@] From $\gamma(t)$ in 1981Da06.

[&] From Recoil-Distance-Method (RDM) in 1976Po03.

^a (A): $\Delta J=1$ sequence.

^b (B): γ sequence based on g.s.

$\gamma(^{43}\text{Sc})$

A₂, A₄ and POL values are from 1976Po03. The ADO values are from priv. comm. (Dec. 9, 2004) from 2004Mo47.

ADO=angular distribution ratio (147°/90°), values are from e-mail reply of December 9, 2004 from the first author.

Expected values are larger than ≈ 1.3 for stretched quadrupole and ≈ 0.6 for stretched dipole transitions.

E γ [†]	E(level)	I γ [‡]	Mult. ^{#@}	δ [#]	Comments
135.8 [‡] 2	3123.4	40.6	E2		I γ : 34.3 (1976Po03). ADO=2.18 17.
151.68 [‡] 17	151.65				
287.7 5	5517.9	2.0	D+Q		ADO=0.83 16.
456.78 [‡] 12	1337.00	19.0	D+Q		I γ : 5.29 (1976Po03). A ₂ =-0.27 10. ADO=0.80 6.

Continued on next page (footnotes at end of table)

$^{27}\text{Al}(^{19}\text{F}, \text{p}2\text{n}\gamma)$ 2004Mo47, 1976Po03 (continued) $\gamma(^{43}\text{Sc})$ (continued)

$E\gamma^\dagger$	E(level)	$I\gamma^\dagger$	Mult.#@	$\delta^\#$	Comments
472.50 20	472.50		E2		$E\gamma$: only seen in 1976Po03. $I\gamma$: 6.35 (1976Po03). $A_2=+0.09$ 3; $A_4=-0.09$ 3. POL=+0.11 19.
588.4 3	3140.8	13.0	D+Q		ADO=0.30 13.
594.6 5	1931.8	86.0 §	M1+E2		$A_2=-0.41$ 9. POL=-0.19 12. ADO=0.46 4.
614.75 ‡ 25	3755.4	18.6	M1+E2	-0.11 8	$I\gamma$: 6.35 (1976Po03). $A_2=-0.73$ 10; $A_4=+0.28$ 10. POL=-0.23 15. ADO=0.47 6.
620.8 ‡ 3	2552.6	9.0	D+Q		$I\gamma$: 4.11 (1976Po03). $A_2=-0.51$ 15. ADO=0.49 9.
675.7 5	7105.1	5.0	D+Q		ADO=0.82 9.
728.64 ‡ 15	880.24	35.6	M1+E2		$I\gamma$: 31.7 (1976Po03). $A_2=-0.52$ 2. POL=+0.23 6. ADO=0.55 5.
764&	6281.4	2.0			
823.7 7	7105.1	8.6			
911.5 6	6429.4	41.7	Q		ADO=1.32 10.
927.0 10	7356.4	22.1	D+Q		ADO=0.83 8.
1051.7 ‡ 4	1931.8	35.9 §	E2		$I\gamma$: 22.8 (1976Po03). $A_2=+0.23$ 3; $A_4=-0.05$ 3. POL=+0.16 9. ADO=1.23 10.
1157.55 ‡ 15	2987.5	87.2	E2		$I\gamma$: 113.6 (1976Po03). $A_2=+0.22$ 4; $A_4=-0.18$ 4. POL=+0.26 6. ADO=1.41 3.
1185.0 ‡ 5	1337.00	67.0	Q		$I\gamma$: 11.1 (1976Po03). Mult.: $\gamma(\text{lin pol})$ result disagrees with expected mult=E2 (1976Po03). $A_2=+0.10$ 3. POL=-0.21 21. ADO=1.33 7.
1202.7 3	3755.4	21.0	Q		ADO=1.11 14.
1209.1 ‡ 5	3140.8	19.1	E2		$I\gamma$: 13.5 (1976Po03). $A_2=+0.29$ 5; $A_4=-0.08$ 5. POL=+0.63 28. ADO=1.29 6.
1215.6 ‡ 4	2552.6	14.0	Q		$I\gamma$: 2.79 (1976Po03). $A_2=+0.37$ 10. ADO=1.17 8.
1258.8 9	4382.2	29.0	D+Q		ADO=0.86 10.
1336.8 15	1337.00	20.0	D		ADO=1.060 10; $\Delta J=0$, dipole.
1394.6 13	4382.2	7.0	D+Q		ADO=0.66 17.
1472.0 10	8828.4	78.0	D+Q		ADO=0.66 7.
1474.9 5	5230.3	6.0	D+Q		ADO=0.59 16.
1509.8 19	4633.2	13.0	D+Q		ADO=0.86 11.
1648&	6281.4	13.0			
1762.6 3	5517.9	44.0	Q		ADO=1.30 16.
1829.8 ‡ 3	1829.9	100	E2		$A_2=+0.16$ 1; $A_4=-0.06$ 1. POL=+0.43 9. ADO=1.39 3.
2270.0 10	8699.5	54.0	D+Q		ADO=0.65 12.
2394.3 5	5517.9	29.2	D		ADO=1.55 15; $\Delta J=0$, dipole.
3077.9 15	6065.5	10.0	D, Q		ADO=1.49 18; $\Delta J=0$, dipole or $\Delta J=2$, quadrupole.
3157.8 20	6281.4	33.0	D+Q		ADO=0.54 8.
3305.8 7	6429.4	38.0	Q		Mult.: 2004Mo47 suggest octupole admixture. ADO=1.93 22.
3691.0 18	6814.5	16.0			ADO=0.90 22.

† From e-mail reply of December 9, 2004 from the first author (T. Morikawa) of 2004Mo47. Intensities from 1976Po03 relative to 100 for 1830 γ are given under comments.

‡ Weighted average from 2004Mo47 and 1976Po03.

§ In comparison with branching ratio of 595 γ and 1051 γ in four reactions, it seems intensities listed in priv. comm. from 2004Mo47 are reversed.

From $\gamma(\theta)$ and $\gamma(\text{lin pol})$ of 2004Mo47 and 1976Po03.

@ Mult=Q implies $\Delta J=2$, mult=D+Q implies $\Delta J=1$ transition.

& Placement of transition in the level scheme is uncertain.

²⁸Si(²⁰Ne,αpγ) ²⁰⁰⁷Ch40

²⁰⁰⁷Ch40: E=84 MeV beam from ATLAS accelerator at Argonne National Laboratory. Target of self-supporting 0.5 mg/cm² ²⁸Si on Ta foil. γ-rays were detected by the Gammasphere array of 102 Compton-suppressed HPGe detectors and charged particles by an array of 95 CsI(Tl) detectors with a 65% efficiency for detection α particles and 50% for protons. Measured Eγ, Iγ, γγ, γ(θ), γγ(θ)(DCO). Deduced levels, J, π, γ branching ratios.

A similar experiment was done by ²⁰⁰⁷Ch40 using the reaction ²⁴Mg(²⁴Mg,αpγ). The γ-ray energies and angular distribution/ correlation coefficients are averages from the two experiments. The coefficients from these measurements are listed in ²⁴Mg(²⁴Mg,αpγ) dataset.

⁴³Sc Levels

E(level) [†]	Jπ	T _{1/2} [‡]	E(level) [†]	Jπ	E(level) [†]	Jπ
0.0 [§]	7/2-		6431.60 ^{& 13}	23/2+	12053.72 ¹⁶	29/2(-)
152.25 ^{& 11}	3/2+	438 μs ⁷	6818.98 ¹⁵	(21/2+)	12073.76 ¹⁸	(29/2-)
845.42 ²⁰	5/2-		7107.43 ^{@ 13}	23/2+	12615.45 ¹⁶	(31/2)-
880.97 ^{a 10}	5/2+		7118.4 ¹⁰		12704.2 ¹⁰	
1337.85 ^{& 9}	7/2+		7273.1 ¹⁰		12804.7 ⁴	
1408.38 ^{# 16}	7/2-		7359.77 ^{a 14}	25/2+	13045.3 ^{@ 3}	(29/2+)
1830.62 ^{§ 9}	11/2-		8010.6 ⁴		13117.20 ¹⁸	(31/2-)
1932.83 ^{a 10}	9/2+		8434.56 ¹⁷	23/2-	13123.1 ⁶	
2554.07 ^{& 10}	11/2+		8555.89 ^{# 14}	23/2-	13584.6 ¹¹	(29/2+)
2635.72 ^{# 12}	11/2-		8703.53 ¹⁵	25/2(+)	14406.61 ¹⁷	(33/2-)
2988.74 ^{§ 11}	15/2-		8832.32 ^{& 16}	27/2+	14452.1 ⁴	(29/2+)
3124.32 ^{§ 13}	19/2-	472 ns ⁴	9219.2 ⁴	(21/2-)	14561.4 ^{# 3}	31/2-
3142.46 ^{a 11}	13/2+		9579.35 ¹⁸	(27/2+)	14916.7 ⁵	31/2
3293.5 ⁵	7/2-		9995.34 ¹⁶	25/2(-)	15911.6 ^{@ 3}	(33/2+)
3756.04 ^{& 11}	15/2+		10084.85 ¹⁴	27/2-	16704.3 ¹¹	
3960.31 ^{# 11}	15/2-		10179.1 ⁶		16708.9 ¹¹	
4301.5 ⁵			10437.43 ^{@ 22}	(25/2+)	16711.5 ¹¹	
4383.67 ²³	17/2(-)		10613.82 ¹⁷	(27/2-)	17769.8 ⁵	(35/2)
5232.02 ^{a 13}	17/2+		10856.86 ¹⁶	(27/2-)	17922.0 ⁵	(31/2+)
5519.53 ^{& 12}	19/2+		11252.6 ¹⁰	25/2+	18197.0 ^{# 11}	35/2-
5793.95 ²³			11355.67 ^{# 22}	27/2-	18767.7 ⁵	(37/2)
6067.70 ^{# 12}	19/2-		11661.3 ⁵		19210.5 ^{@ 4}	(37/2+)
6173.53 ^{@ 14}	19/2+		11807.67 ¹⁷	29/2(-)		
6284.04 ^{a 14}	21/2+		11921.6 ⁵	25/2(+)		

[†] From least-squares fit to Eγ data. The normalized χ²=5.8 for the uncertainties as quoted by ²⁰⁰⁷Ch40. This value is much larger than the critical χ²=1.5. The uncertainties of the following ten γ-rays were increased by a factor of 2 or 3 to get an acceptable fit with normalized χ²=2.5: 287.9, 860.4, 1157.5, 1595.2, 2177.8, 2369.6, 2418.3, 2598.0, 2725.6, 6081.0. It should be that the uncertainties for level energies quoted in Table V of ²⁰⁰⁷Ch40 are much larger than those given here.

[‡] From Adopted Levels.

[§] (A): γ sequence based on g.s.

[#] (B): γ sequence based on 7/2-.

[@] (C): γ sequence based on 19/2+.

[&] (D): γ sequence based on 3/2+.

^a (E): γ sequence based on 5/2+.

γ(⁴³Sc)

The DCO values are for ≈90° (range of 69.8°–110.2°) and forward/ backward angles (50.1°–129.9° range). The gates are on ΔJ=2, quadrupole or ΔJ=0, dipole transitions, unless otherwise stated. Expected values for ΔJ=1, dipole gate are: 1.6 for ΔJ=2, quadrupole or ΔJ=0, dipole; 1.0 for ΔJ=1, dipole; 0.5 to 1.9 for ΔJ=1, dipole+quadrupole; 1.1 to 1.7 for ΔJ=0, dipole+quadrupole. Expected values for ΔJ=2, quadrupole gate are: 1.0 for ΔJ=2, quadrupole or ΔJ=0, dipole; 0.6 for ΔJ=1, dipole; 0.3 to 1.2 for ΔJ=1, dipole+quadrupole; 0.6 to 1.1 for ΔJ=0, dipole+quadrupole. See ²⁴Mg(²⁴Mg,αpγ) dataset for values of the coefficients from these measurements

Eγ [†]	E(level)	Iγ	Mult. [‡]	Eγ [†]	E(level)	Iγ	Mult. [‡]
135.5 ¹	3124.32	3.19 ¹⁸		613.5 ¹	3756.04	31.3 ⁹	D
252.3 ¹	7359.77	2.26 ⁸		621.3 ¹	2554.07	5.73 ¹⁹	D
287.9 ^{§ 1}	5519.53	1.96 ⁷	D	645.4 ¹	6818.98	1.33 ⁷	
288.4 ¹	7107.43	0.58 ³		653.9 ²	6173.53	0.66 ⁶	
456.7 ¹	1337.85	3.60 ¹⁴		675.9 ¹	7107.43	7.33 ²⁴	D
562.9 ²	1408.38	0.57 ⁴		728.7 ¹	880.97	50.8 ¹⁹	D
588.2 ¹	3142.46	2.88 ¹⁰		764.3 ¹	6284.04	2.29 ¹²	D
595.1 ¹	1932.83	10.8 ³		766.9 ²	3756.04	0.97 ⁵	D

Continued on next page (footnotes at end of table)

²⁸Si(²⁰Ne,αpγ) 2007Ch40 (continued)

γ(⁴³Sc) (continued)

Eγ [†]	E(level)	I _γ	Mult. [‡]	Eγ [†]	E(level)	I _γ	Mult. [‡]
771.6 4	10856.86	0.53 6		2369.6# 4	8434.56	1.26 7	
804.4 3	2635.72	0.90 8	D	2394.9 1	5519.53	82 3	D
823.3 1	7107.43	5.24 19		2418.3§ 2	6173.53	1.18 6	
845.3 3	845.42	0.29 4		2488.2 1	8555.89	13.9 4	Q
860.4# 2	10856.86	0.51 4	D	2491.0 3	8010.6	2.69 16	
880.5 2	880.97	1.65 10		2503.1 1	13117.20	3.68 14	Q&
912.0 1	6431.60	100 3	Q	2508.0 3	14561.4	1.67 8	
928.2 1	7359.77	75.4 24	D	2530.4 1	14452.1	3.02 12	
933.0 5	7107.43	0.93 7		2530.6 1	12615.45	12.7 4	Q
941.4 1	6173.53	1.11 5		2598.0# 1	14406.61	2.91 11	(Q)
951.0 3	11807.67	1.23 6	D	2607.8 2	13045.3	1.12 5	
971.5 1	3960.31	2.18 8	D	2636.0 3	2635.72	2.6 4	
997.9 1	18767.7	0.87 4	D	2644.5 5	14452.1	0.97 6	
1043.6 1	13117.20	1.19 6	D	2725.6§ 1	10084.85	1.93 10	D
1051.9 1	1932.83	28.5 9	Q	2799.5 2	11355.67	2.70 10	Q
1052.9 4	6284.04	0.07 4		2852.9 1	17769.8	3.06 11	(Q)
1075.6 3	7359.77	0.70 7		2866.3 2	15911.6	3.50 12	
1157.5# 1	2988.74	15.2 6	Q	2887.4 6	9995.34	0.90 6	
1185.6 1	1337.85	9.2 4	Q	2920.2 10	11355.67	0.39 5	
1202.1 1	3756.04	5.76 19		2975.2 1	11807.67	6.45 21	D@
1209.7 1	3142.46	30.9 9	Q	3038.1 5	13123.1	1.27 9	
1216.1 1	2554.07	4.45 17		3048.6 8	6173.53	0.38 9	
1227.1 3	2635.72	2.37 19		3071.6 5	10179.1	0.90 6	
1289.2 3	14406.61	0.46 4		3079.0 1	6067.70	4.92 17	Q
1324.5 1	3960.31	2.57 11	Q	3105.3 4	11661.3	0.70 4	
1338.0 1	1337.85	2.51 12	D	3124.2 3	16708.9	1.03 5	
1360.6 4	3293.5	0.65 6		3147.7 2	9579.35	2.80 11	
1381.2 1	10084.85	3.52 12	D	3151.4 3	9219.2	1.53 7	(D)@
1394.9 2	4383.67	1.75 8	D	3159.8 2	6284.04	10.0 5	D&
1408.3 2	1408.38	3.3 8	D	3205.3 3	14561.4	2.09 9	Q@
1439.5 1	9995.34	2.66 10	D	3253.9 1	10613.82	8.5 3	D
1440.7 2	19210.5	0.79 4		3296.0 4	15911.6	1.24 7	
1460.1 1	12073.76	3.12 13	D&	3298.8 3	19210.5	1.58 7	
1472.5 1	8832.32	35.9 11	D	3307.6 2	6431.60	8.9 3	[M2]
1476.0 1	5232.02	5.49 20		3329.9 2	10437.43	2.04 9	
1529.0 1	10084.85	4.63 16	Q	3362.2 10	7118.4	0.40 5	
1586.9 3	6818.98	0.39 4		3469.8 2	17922.0	1.74 8	(D)
1595.2§ 3	8703.53	1.09 7		3497.0 1	10856.86	4.99 18	D
1650.3 1	10084.85	10.7 4	Q	3516.9 5	7273.1	0.55 4	
1724.8 2	8832.32	2.10 10		3586.9 5	16704.3	0.47 3	
1757.9 7	12615.45	1.71 9		3635.4 3	18197.0	1.31 6	Q@
1763.3 1	5519.53	22.0 7	Q	3892.6 3	11252.6	2.96 12	
1791.2 1	14406.61	6.06 21	D	3906.6 5	16711.5	0.58 5	
1830.5 1	1830.62	22.9 14	Q	3972.5 2	12804.7	1.75 7	
1833.6 2	5793.95	2.85 13		3997.1 3	11355.67	1.23 7	
1968.8 1	12053.72	6.30 25	D	4148.1 8	12704.2	0.32 3	
2058.7 2	12053.72	1.23 7		4213.0 3	13045.3	1.88 7	D@
2107.3 1	6067.70	16.5 5	Q	4341.7 3	13045.3	1.66 7	
2129.7 1	3960.31	15.1 5	Q	4560.5 3	11921.6	1.89 8	D
2177.8§ 6	10613.82	0.40 5	Q@	4752.0 3	13584.6	1.33 6	D@
2190.8 3	12804.7	1.19 6		5310.5 1	8434.56	13.8 10	Q@
2219.2 2	9579.35	2.43 10		5489.0 3	11921.6	3.19 12	D
2228.0 2	11807.67	1.76 8		5620.1 5	14452.1	1.45 7	
2271.8 1	8703.53	9.9 3	D	5684.9 4	13045.3	1.52 7	
2353.2 3	14406.61	1.57 8	Q@	6081.0§ 3	14916.7	4.69 16	Q
2368.6 5	4301.5	0.99 7					

[†] The quoted uncertainties are statistical only. Above 3.5 MeV (maximum range of calibration curve), systematic uncertainties can be 1-2 keV.

[‡] 2007Ch40 assign multiplicities for most of the transitions, many based only on J_π assignments. The evaluators assign mult=D for ΔJ=0,1 M1 or E1 and Q for ΔJ=2, Q transitions for which supporting angular distribution/correlation data are available. Dipole transitions with expected M1 character may include E2 component.

[§] Poor fit in the level scheme. The uncertainty is increased by a factor of 2 for fitting purposes.

²⁸Si(²⁰Ne,αpγ) 2007Ch40 (continued)

^γ(⁴³Sc) (continued)

- # Poor fit in the level scheme. The uncertainty is increased by a factor of 3 for fitting purposes.
 @ DCO value corresponds to an alternative DCO-like analysis.
 & DCO value corresponds to gate on ΔJ=2, quadrupole transition.

²⁹Si(¹⁶O,pnγ) 1980Sh09

1980Sh09: E=40, 42 MeV ¹⁶O beam. Target of a 200 μg/cm² ²⁹Si (enriched to 95%) on a 250 μm gold backing. γ-rays were detected by Ge(Li) detectors. Measured E_γ, I_γ, γγ, γγ(t), γ(θ), γ(lin pol). Deduced levels, J, π, mixing ratios, γ-branchings, T_{1/2} by Doppler-shift attenuation method (DSAM).

⁴³Sc Levels

E(level) [†]	Jπ [‡]	T _{1/2}
0.0	7/2-	
1829.94 20	11/2-	
2987.5 4	15/2-	
3123.3 5	19/2-	
5517.3 8	19/2+	<62 fs [§]
6428.6 9	23/2+	16.3 ps [#] 15
7354.8 11	25/2+	0.42 ps [§] 11

[†] From least-squares fit to E_γ data.

[‡] From Adopted Levels.

[§] DSAM (1980Sh09).

[#] RDM (1980Sh09).

^γ(⁴³Sc)

E _γ [†]	E(level)	I _γ [†]	Mult. [‡]	δ [‡]	Comments
135.8 3	3123.3	14 1	E2		A ₂ =+0.36 5, A ₄ =-0.09 5 (1980Sh09). δ(O/Q)=0.00 1.
911.3 5	6428.6	11 1	E2		A ₂ =+0.32 2, A ₄ =-0.25 2. Pol=+0.67 9 (1980Sh09). δ(M3/E2)=0.00 2.
926.2 5	7354.8	4.0 5	M1(+E2)	-0.1 1	Mult.,δ: from A ₂ =-0.14 5, A ₄ =0.00 5. Pol=-0.4 5 (1980Sh09).
1157.5 3	2987.5	71 2	E2		A ₂ =+0.30 2, A ₄ =-0.12 2. Pol=+0.48 7 (1980Sh09). δ(M3/E2)=0.00 1.
1829.9 2	1829.94	100 3	E2		A ₂ =+0.26 2, A ₄ =-0.10 2. Pol=+0.45 9 (1980Sh09). δ(M3/E2)=0.00 1.
2393.9 7	5517.3	14 1	E1(+M2)	0.0 1	Mult.,δ: A ₂ =+0.43 3, A ₄ =0.00 4. Pol=-0.8 4 (1980Sh09).
3305.5 15	6428.6	1.0 5	M2+E3	+0.27 9	I _γ (3305)/I _γ (911)=0.07 1. Mult.,δ: A ₂ =+0.69 15, A ₄ =+0.24 11 (1980Sh09).

[†] From 1980Sh09.

[‡] From γ(θ) and γ(lin pol) of 1980Sh09.

⁴⁰Ca(α,p) 1981Sm03,1970Gi10,1967Sc08

1981Sm03: E=35.6 MeV α beam was produced from the University of Colorado cyclotron. Target of natural calcium on a 20 μg/cm² carbon foil, thickness of 280 μg/cm². Protons were momentum analyzed with a magnetic spectrograph and detected in the helical focal plane counter backed by a plastic scintillator, overall FWHM=25-30 keV. Measured σ(E_p,θ). Deduced levels, J, π from DWBA analysis.

1970Gi10 (also 1966GiZZ): E=31 MeV α beam was produced from the MIT cyclotron. Target of 1 mg/cm² 97% enriched self-supporting ⁴⁰Ca foil. Protons were detected by a ΔE-E solid-state counter telescope, FWHM=90 keV. Measured σ(E_p,θ). Deduced levels, J, π, L from DWBA analysis.

1967Sc08: E=12 MeV α beam was produced from the tandem Van de Graaff accelerator at Argonne National Laboratory. Target of 10 μg/cm² natural calcium on a 10 μg/cm² carbon backing. Protons were momentum analyzed with a 75 cm broad-range magnetic spectrograph and detected in nuclear emulsions. Measured σ(E_p,θ). Deduced levels.

Continued on next page (footnotes at end of table)

⁴⁰Ca(α,p) 1981Sm03,1970Gi10,1967Sc08 (continued)

- 1987Fr09: E=12 MeV α beam was produced from the 6 MV Van de Graaff accelerator of the National Accelerator Center (NAC) at Faure. Target of natural CaO on a thin carbon backing. Particles scattered at 90° and 120° to the beam were detected by a ΔE-E detector telescope. Measured relative cross sections compared to those calculated from Hauser-Feshbach analysis for possible Jπ assignments. Deduced levels.
- 1979Th03: E=25 MeV α beam was produced from the Niels Bohr Institute FN tandem Van de Graaff accelerator. Target of a 15 μg/cm² 81.9% enriched ⁴¹Ca (81.9% in ⁴¹Ca and 18.1% in ⁴⁰Ca) on a carbon backing. Protons were analyzed with a single-gap magnetic spectrograph and detected in nuclear emulsions. Measured σ(E_p,θ). Deduced levels, J, π from DWBA analysis for 0, 1179, 1811 and 1830 levels. In the spectrum, 13 groups assigned to ⁴³Sc.
- 1985Ba77: E=25.8 MeV. Measured σ(θ), DWBA analysis. Data for 0, 472, 1179 levels.
- 1970Ba51: E=11.94 MeV. FWHM=50 keV. Particle spectrum in coin with γ-rays.
- 1983HaZJ: E=60 MeV. Measured σ(θ). DWBA calculations.
- 1974Ho39: E=4-10 MeV. Measured cross section.
- 1972Fi20: E=28.5 MeV. Measured σ(θ). DWBA calculations.
- 1971Po03: E=9.5, 11 MeV. Measured proton spectrum FWHM=150 keV. DWBA calculations.
- 1966Cu01: E=9, 10 MeV. Measured σ(θ). FWHM=25 keV. DWBA calculations.
- 1963La04: E=20 MeV or less. Measured σ(θ) for selected groups. A total of 14 groups reported.
- 1961Ma03: E=21 MeV. Measured Q-value.

Relative total cross sections (1987Fr09)

Level	cross section
1811	3.9 5
1829	9.6 11
1963	4.5 5
2094	3.6 5
2106	5.4 8
2141	4.9 6
2243	5.9 6
2289	4.1 5
2335	4.0 5
2382	3.1 4
2459	6.5 7
2551	6.7 7
2580	4.4 5
2669	2.9 4
2762	5.6 7

⁴³Sc Levels

E(level) [‡]	Jπ [†]	L ^c	σ(DWBA)/σ(exp) ^b	Comments
0.0	7/2-	3	0.258	
151 ^a 2				
473 ^{&} 2	3/2-	1	0.358	S-factor=0.267, 0.280 (relative to 1 for g.s.) (1985Ba77).
844 ^{&} 2	5/2-		0.265	
855 [@]				
882 ^a 2				
1156 ^{&} 2				
1178 ^{&} 2	3/2-	1		S-factor=1.22, 1.28 (relative to 1 for g.s.) (1985Ba77), 1.39 (1981Sm03).
1335 ^a 2				
1418 ^{&} 2	7/2-	3	0.024	
1646 ^a 2				
1810 ^{&} 2			0.394	Jπ: 1981Sm03 assign 1/2-, but adopted Jπ=3/2-. Also σ(θ) fitted well to 3/2- by 1979Th03.
1827 ^{&} 2	11/2-	5	0.168	
1877 ^a 2				
1912 [§] 6				
1928 ^{&} 2				
1963 [#]				
2094 [#]				
2106 [#]				
2141 [#]				
2243 [#]				
2289	5/2-	3		
2335 [#]				
2382 [#]				
2459 [#]				

Continued on next page (footnotes at end of table)

$^{40}\text{Ca}(\alpha, p)$ 1981Sm03, 1970Gi10, 1967Sc08 (continued) **^{43}Sc Levels (continued)**

$E(\text{level})^\dagger$	$J\pi^\ddagger$	L^c	$\sigma(\text{DWBA})/\sigma(\text{exp})^b$	Comments
2551#				
2580#				
2634	(9/2-)		0.110	$J\pi$: adopted $J\pi=(9/2, 11/2)-$.
2669#				
2762#				
2810@				
2839@				
2987	15/2-	7d	0.379	$J\pi$: 1970Gi10 fit a 2980 group to $J=1/2$.
3123	(19/2-)	9d	1.0	
3141@				
3250?				
3289@				
3450?				
3485@				
3677@				
3807@				
3850?				$E(\text{level})$: from 1963La04 only.
3955@				
3990@				
4157@				
4370				
4630				
4940				
5230				
5340				
5690				
6080				
6230				

† From comparison of $\sigma(\theta)$ data with cluster transfer DWBA calculations (1981Sm03, 1970Gi10).

‡ From 1981Sm03 up to 3200 and from 1970Gi10 above 3200, unless otherwise stated.

§ From 1966Cu01.

$^\#$ From 1987Fr09.

@ From 1970Ba51, protons detected in coin with γ -rays.

& From 1967Sc08.

^a Weighted average of 1966Cu01 and 1967Sc08.

^b From 1981Sm03, normalized to 1.0 for 3123, (19/2-) state.

^c From 1970Gi10, unless otherwise indicated.

^d From 1983HaZJ.

 $^{40}\text{Ca}(\alpha, p\gamma)$ 1987Fr09, 1972Ba04, 1971Po03

1987Fr09: $E=12$ MeV α beam was produced from the 6 MV Van de Graaff accelerator of the NAC at Faure. Target of natural CaO on a thin carbon backing. γ -rays were detected by Ge(Li) detectors and protons were detected at forward angles by two surface barrier detectors. Measured $E\gamma$, $I\gamma$, $p\gamma$ -coin. Deduced levels, γ -branching ratios, mixing ratios, $T_{1/2}$ by DSAM.

1972Ba04, 1970Ba51: $E=7-12$ MeV (1972Ba04), $E=11.8-15.5$ MeV (1970Ba51) α beam was produced from the Chalk River MP Tandem accelerator. Targets of $400 \mu\text{g}/\text{cm}^2$ natural Ca on thick gold backings. γ -rays were detected in a 44 cm^3 Ge(Li) detector inside a split annular NaI(Tl) detector and protons were detected by an annular surface barrier detector. Measured $E\gamma$, $I\gamma$, $p\gamma(\theta)$, $p\gamma$ -coin. Deduced levels, J , π , mixing ratios, γ -branching ratios, $T_{1/2}$ by DSAM.

1971Po03: $E=9.5$ MeV and 11.0 MeV α beam was produced from the Utrecht 2×6 -MV tandem Van de Graaff, current of up to $0.25 \mu\text{A}$. Target of natural CaCO_3 on a thick carbon backing. γ -rays were detected in a 36-cc Ge(Li) detector and protons by two silicon surface barrier detectors. Measured $E\gamma$, $p\gamma$ -coin. Deduced levels, $T_{1/2}$ by DSAM.

Others:

1987Ar18: $E=20$ MeV. Isomer production and decay.

1980ShZN: measured $E\gamma$, $I\gamma$, $p\gamma$ coin, $\gamma(\theta)$, $\gamma(\text{lin pol})$, lifetimes by DSAM.: details of this work are not available.

1978Ha07: $E=21$ MeV. Measured g factor and lifetime of $19/2-$ state by $\gamma(\theta, \text{H}, t)$ (TDPAD method).

1977Mi10: $E=20$ MeV. Measured g factor of $15/2$ level by $\gamma(\theta, \text{H}, t)$.

1974Br04 (also 1974BrYR): $E=14.0$ MeV. Measured lifetime of 2987 level by recoil-distance method.

1973Sa10: $E=12.2, 13.2, 14.2$ MeV. Measured $E\gamma$, $\gamma\gamma$, lifetimes by Doppler-shift method.

1971Na10: $E=19$ MeV. Measured lifetime and g factor of $19/2-$ level by $\alpha\gamma(\theta, \text{H}, t)$.

Continued on next page (footnotes at end of table)

⁴⁰Ca(α ,p γ) 1987Fr09,1972Ba04,1971Po03 (continued)

1971Ba92: E=10.6 MeV. Measured lifetime of four levels by recoil-distance method:
 1970Sa24: E=10-26 MeV. Measured decay mode and lifetime of 19/2- level.
 1970Fo06: E=7-12 MeV. Measured E γ , γ (0), lifetimes of four levels by Doppler-shift attenuation method.
 1968Me14: E=10 MeV. Measured lifetime of 472 level by p γ (t).
 1967Ph01: E=9.00, 9.35 MeV. Measured E γ , γ (0).
 1967Cr08: E=9.5 MeV. Measured lifetime of 472 level by RDM.
 1967Sc08: E=12 MeV. Measured E γ , I γ , p γ -coin. Deduced levels.
 1966WaZW: measured ce, deduced α (K)(expt) and K/L ratios for 152 γ and 472 γ .
 1965De15: E=22 MeV. Measured lifetime of 150-keV isomer.
 1964Ho14: E=8 MeV. Also ⁴³Ca(p,n γ) E=6 MeV. Measured lifetime of the 150-keV isomer.
 1964Sa26: measured E γ , $\gamma\gamma$, deduced resonances.

⁴³Sc Levels

E(level) [†]	J π [‡]	T _{1/2} [§]	Comments
0.0	7/2-		
151.6 3	3/2+	438 μ s 7	g=+0.232 4 (1977Mi10). T _{1/2} : 470 μ s 20 (1965De15), 435 μ s 7 (1964Ho14).
471.9 2	3/2-	158 ps 13	T _{1/2} : 152 ps 21 (RDM,1971Ba92), 360 ps 104 (RDM,1967Cr08), 157 ps 13 (1968Me14), >7.6 ps (1971Po03).
843.9 3	5/2-	0.17 ps 6	T _{1/2} : 166 fs 35 (1971Po03), 0.31 ps 6 (1972Ba04), 76 fs +69-42 (1987Fr09).
853.4 9	1/2+	22 ps 3	T _{1/2} : from 1971Ba92 by RDM. Others: >0.43 ps (1971Po03), >4.2 ps (1972Ba04).
879.9 4	5/2+	4.2 ps 10	T _{1/2} : from 1971Ba92 by RDM. Others: 4.0 ps +18-10 (DSAM,1970Fo06, 1972Ba04), 0.56 ps +19-13 (1971Po03), >1.73 ps (1987Fr09).
1158.0 5	3/2+	4.4 ps 10	T _{1/2} : from 1971Ba92 by RDM. Others: 2.1 ps +25-8 (1971Po03); 236 fs +388-125 (1987Fr09), 3.5 ps +14-8 (1972Ba04).
1177.0 8	3/2-	0.49 ps 14	T _{1/2} : 0.34 ps +16-11 (1971Po03), 0.59 ps 10 (1972Ba04).
1336.8 2	7/2+	0.83 ps 35	T _{1/2} : 1.39 ps 28 (DSAM,1970Fo06,1972Ba04), 0.58 ps +24-14 (1971Po03).
1406.1 3	7/2-	0.19 ps 6	T _{1/2} : 166 fs 31 (1971Po03); 0.27 ps 4 (1972Ba04), 159 fs +118-55 (1987Fr09).
1650.3 6	5/2+	0.17 ps 3	T _{1/2} : 204 fs +87-65 (1971Po03), 0.159 ps 35 (1972Ba04).
1810.7 8	3/2-	<55 fs	T _{1/2} : from 1972Ba04.
1829.3 3	11/2-	0.20 ps 3	T _{1/2} : 80 fs +104-74; 211 fs 44 (1971Po03); 0.26 ps 4 (1972Ba04), 132 fs +69-42 (1987Fr09).
1882.3 5	(5/2,9/2)-	35 fs 17	T _{1/2} : <21 fs; 57 fs +42-36 (1971Po03); 0.055 ps 21 (1972Ba04), 17 fs 14 (1987Fr09). J π : 7/2 choice does not seem allowed from p γ (0) (1970Ba51).
1930.6 5	9/2+	2.4 ps 6	T _{1/2} : from DSAM (1970Fo06,1972Ba04). Others: 0.83 ps + ∞ -50; 1.0 ps +27-4 (1971Po03); >1.39 ps (1987Fr09).
1962.5 5	(3/2,5/2)-	<83 fs	T _{1/2} : from 1987Fr09, 1972Ba04. J π : 5/2 is preferred in p γ (0) (1970Ba51).
2093.9 12	3/2-	0.33 ps 9	T _{1/2} : 0.34 ps +15-10 (1971Po03), 0.32 ps 9 (1972Ba04).
2105.7 5	(3/2,5/2)	0.21 ps 7	T _{1/2} : 121 fs +69-42 (1987Fr09), 0.28 ps 6 (1972Ba04).
2141.2 6	(3/2-,5/2+)	0.21 ps 4	T _{1/2} : 0.19 ps +11-9 (1971Po03); 0.24 ps 10 (1972Ba04), 159 fs +395-111 (1987Fr09).
2242.6 4	(3/2,5/2,7/2)-	0.19 ps 9	T _{1/2} : 0.30 ps 11 (1972Ba04), 194 fs +118-63 (1987Fr09).
2288.8 4	5/2-	<21 fs	T _{1/2} : from 1972Ba04. Other: <2.1 fs (1987Fr09).
2335.4 4	5/2-	28 fs 14	T _{1/2} : from 1987Fr09. Other: <0.042 ps (1972Ba04).
2382.1 11	3/2(+)	>0.31 ps	T _{1/2} : from 1987Fr09.
2458.6 5	(5/2 to 9/2)-	38 fs 14	T _{1/2} : from 1987Fr09. Other: <0.042 ps (1972Ba04).
2550.7 6	11/2+	0.51 ps 7	T _{1/2} : from DSAM (1970Fo06,1972Ba04). Other: 270 fs +242-111 (1987Fr09).
2579.9 4	(5/2)	0.19 ps +19-9	T _{1/2} : from 1987Fr09.
2635.5 7	9/2-,11/2-	0.21 ps 7	T _{1/2} : from 1972Ba04. Other: 520 fs +1143-243 (1987Fr09).
2650.5 16			
2669 2	3/2-		
2762.2 4	(5/2 to 9/2)-	<28 fs	T _{1/2} : from 1987Fr09. Other: <0.042 ps (1972Ba04).
2795.2 5		0.28 ps +21-10	T _{1/2} : from 1987Fr09.
2810.7 8	(5/2,7/2,9/2)	<62 fs	T _{1/2} : from 1987Fr09. Other: <0.083 ps (1972Ba04).
2840.0 5	(5/2,7/2)+		
2846			
2862.7 18	(1/2,3/2,5/2)+		
2984.1 8	(3/2,5/2)	62 fs 28	T _{1/2} : from 1972Ba04. Other: 97 fs +159-73 (1987Fr09).
2987.6 4	15/2-	5.6 ps 7	T _{1/2} : from 1974Br04, other: >0.55 ps (1987Fr09).

Continued on next page (footnotes at end of table)

⁴⁰Ca(α , γ) 1987Fr09,1972Ba04,1971Po03 (continued)

⁴³Sc Levels (continued)

E(level) [†]	J π [‡]	T _{1/2} [§]	Comments
3123.2 3	19/2-	473 ns 5	T _{1/2} : from 1978Ha07. Others: 450 ns 14 (1971Na10), 0.5 μ s 1 (1970Sa24). g=+0.3286 7 (1978Ha07). g: other: +0.331 2 (1971Na10).
3139.9 7	13/2+	>0.55 ps	T _{1/2} : from 1987Fr09.
3158.8 13	(3/2-, 5/2, 7/2+)	<0.42 ps	T _{1/2} : from 1987Fr09.
3197.6 18		<0.28 ps	T _{1/2} : from 1987Fr09.
3264.0 6	(7/2, 9/2)-	42 fs +28-21	T _{1/2} : from 1987Fr09.
3293.7 6	7/2-	>55 fs	T _{1/2} : from 1987Fr09.
3334 1		0.13 ps +12-7	T _{1/2} : from 1987Fr09.
3375.2 5	(7/2, 9/2)-	<62 fs	T _{1/2} : from 1987Fr09.
3451.2 9	5/2+	<2.1 fs	T _{1/2} : from 1987Fr09.
3463.3 14	5/2-		
4157			E(level): from 1970Ba51 only.

[†] From 1987Fr09.

[‡] From Adopted Levels.

[§] Weighted averages of values given in comments, unless otherwise stated.

 $\gamma(^{43}\text{Sc})$

E(level)	E γ [†]	I γ [§]	Mult. [#]	δ [#]	α	Comments
151.6	151.6	100	M2		0.0406	Mult.: from α (K)(expt)=0.031 2, K/L(expt)=9.0 7 (1966WaZW).
471.9	320.3	4 2				
	471.9	96	E2			Mult.: from α (K)(expt)=7.7 $\times$ 10 ⁻⁴ 19 (1966WaZW). A ₂ =+0.075 34 (1967Ph01).
843.9	692.3	<4				
	843.9	100	M1+E2	+0.11 2		δ : average of +0.09 2 (1987Fr09), +0.12 3 (1970Ba51). Other: 0.13 (1967Ph01). A ₂ =-0.30 3 (1967Ph01). I γ (383)/I γ (703)=25/75 (1987Fr09).
853.4	381.5	30 6				
	701.8	70 6				
879.9	728.3	100	M1+E2	-0.61 24		δ : from 1970Ba51. Others: -1.18 7 (1987Fr09), 0.16 (1967Ph01). A ₂ =-0.703 14, -0.44 3 (1967Ph01).
	879.9	2 1				
1158.0	278.1	19 4				I γ (278)/I γ (1006)=17/55 (1987Fr09).
	304.6	33 5				I γ (303)/I γ (1006)=28/55 (1987Fr09).
	314.1	<3				
	1006.4	48 6	M1+E2	-1.3 +6-15		δ : from 1970Ba51. Others: -0.51 5 or -4.5 +12-25 (1987Fr09), 0.85 or 2.2 (1967Ph01). A ₂ =-0.51 6 (1967Ph01). I γ (334)/I γ (707)=8/68 (1987Fr09).
1177.0	333.1	19 6				
	705.1	68 4	M1+E2	-0.18 13		δ : -0.18 13 or <-22 or >+4.9 (1970Ba51). I γ (1179)/I γ (707)=19/73 (1987Fr09).
1336.8	456.9	19 3	M1+E2	-0.23 4		I γ (457)/I γ (1185)=23/64 (1987Fr09). δ : from 1970Fo06. Others: -0.28 10 or -1.20 18 (1970Ba51). δ : +0.02 3 (1987Fr09) for 7/2 to 3/2. A ₂ =+0.48 6, A ₄ =-0.27 7 (1967Ph01). I γ (1337)/I γ (1185)=13/64 (1987Fr09). δ : from 1970Ba51. Others: -0.03 7 (1987Fr09), +1.8 +7-5 (1970Ba51).
	1185.2	61 3	E2			
	1336.8	20 3	E1+M2	-0.10 8		
1406.1	562.2	10 2				I γ (563)/I γ (1406)=10/82 (1987Fr09).
	934.2	3 1				I γ (936)/I γ (1406)=9/82 (1987Fr09).
	1406.1	90 2	M1+E2	+0.15 5		δ : from 1970Ba51. Others: -0.16 5 (1987Fr09), 0.02 (1967Ph01). A ₂ =+0.50 4 (1967Ph01). I γ (492)/I γ (1499)=21/58 (1987Fr09). I γ =12 (1967Ph01). I γ (771)/I γ (1499)=7/58 (1987Fr09).
1650.3	492.3	22 3				
	770.4	7				
	796.9	4 2				

Continued on next page (footnotes at end of table)

$^{40}\text{Ca}(\alpha, p\gamma)$ 1987Fr09, 1972Ba04, 1971Po03 (continued) $\gamma(^{43}\text{Sc})$ (continued)

E(level)	$E_{\gamma}^{\dagger}$	$I_{\gamma}^{\S}$	Mult.#	$\delta^{\#}$	Comments
1650.3	1178.4 1498.7	57 5	M1 (+E2)	0.06	E_{γ}, I_{γ} : unresolved from 1179 γ from 1179 level. $I_{\gamma}=12$ (1967Ph01). δ : from 1967Ph01. $A_2=+0.55$ 4 (1967Ph01). δ : 0.0 (1967Ph01). $I_{\gamma}(1651)/I_{\gamma}(1499)=14/58$ (1987Fr09). $A_2=+0.19$ 5 (1967Ph01).
	1650.3	17 3			
1810.7	633.7 1338.8	55 4 45 4	M1+E2 M1+E2	-0.22 7 -0.22 7	δ : from 1970Ba51. Other: >+8 or <-19 (1970Ba51). δ : from 1970Ba51. Other: >+8 or <-19 (1970Ba51). $I_{\gamma}(1339)/I_{\gamma}(632)=43/42$ (1987Fr09).
	1659.1 1810 $\frac{7}{2}^{\oplus}$ 1829.3	16			$E_{\gamma}, \text{Mult.}$: this γ is suspect since implied E3 multipolarity is inconsistent with RUL. $E_{\gamma}, \text{Mult.}$: this γ is suspect since implied M4 multipolarity is inconsistent with RUL.
	1677 $\frac{7}{2}^{\oplus}$				E_{γ} : from 1970Sa24.
1882.3	1830.1 5 1038.4 $^{\oplus}$ 1730 $\frac{7}{2}^{\oplus}$ 1882.3	100 <5 100	M1+E2		δ : -0.19 2 for 9/2 to 7/2, +0.42 3 or +4.1 5 for 5/2 to 7/2 (1970Ba51); -0.22 3 or -1.37 6 for 9/2 to 7/2 (1987Fr09). $I_{\gamma}(595)/I_{\gamma}(1051)=25/75$ (1987Fr09). δ : weighted average of -0.14 6 (1970Ba51), -0.24 4 (1970Fo06). δ : -0.02 2 (1987Fr09) for 9/2 to 5/2. $E_{\gamma}, \text{Mult.}$: this γ is suspect since implied M3 multipolarity is inconsistent with RUL.
1930.6	593.8 1050.7 1779 $\frac{7}{2}^{\oplus}$	31 3 69 3	M1+E2 E2	-0.21 4	δ : from 1970Ba51. Other: >+9 or <-17 (1970Ba51).
1962.5	785.5 1490.6	20 80	M1+E2	+0.21 6	δ : from 1970Ba51. Other: >+9 or <-17 (1970Ba51).
2093.9	916.9 1250.0 $^{\oplus}$ 1622.0	58 7 7 7 31			$I_{\gamma}(1942)/I_{\gamma}(915)=16/52$ (1987Fr09).
2105.7	1942.3 455.4 $^{\oplus}$ 947.7 1225.8 1954.1 $^{\oplus}$	35 6 10 5 32 5 58 6 6			$I_{\gamma}(948)/I_{\gamma}(1226)=19/73$ (1987Fr09).
2141.2	983.2 1261.3 1669.3 1989.6 2141.1	21 55 5 19 3 16 3 10 4			$I_{\gamma}(1990)/I_{\gamma}(1261)=26/53$ (1987Fr09).
2242.6	1398.7 1770.7	25 57			δ : +0.58 13 for 5/2 to 3/2, +0.14 8 or +2.5 +6-4 for 3/2 to 3/2 (1970Ba51).
	2242.5	18			
2288.8	2288.7	100.0 7	M1+E2	+0.08 5	δ : from 1970Ba51. Others: +0.35 4 (1987Fr09), -12 +4-12 (1970Ba51).
2335.4	2335.3	100	M1 (+E2)		δ : +0.12 3 for 5/2 to 7/2 (1987Fr09), +0.03 3 or -6.9 +21-14 for 5/2 to 7/2 and +0.07 2 or >+6 or <-29 for 9/2 to 7/2 (1970Ba51).
2382.1	731.8 1528.7	69 31	M1+E2	+0.49 7	δ : from 1987Fr09.
2458.6	2458.5	100	M1 (+E2)		δ : +0.15 7 or >+19 or <-11 for 5/2 to 7/2 and -0.02 5 for 9/2 to 7/2 (1970Ba51).
2550.7	620.1 1213.9	61 4 39 4			δ : -0.06 4 or -2.6 3 (1987Fr09) for 11/2 to 9/2; -0.20 7 for 11/2 to 9/2 (1970Fo06). δ : 0.00 4 (1987Fr09) for 11/2 to 7/2. $I_{\gamma}(1215)/I_{\gamma}(621)=46/54$ (1987Fr09).
2579.9	1421.9 1700.0 2428.2	36 16 48			
2635.5	806.2 1229.4 2635.4	17 23 60			δ : +0.15 15 for 7/2 to 7/2, +0.49 7 for 9/2 to 7/2 (1987Fr09); -0.42 14 or -1.5 +5-7 for 5/2 to 7/2, -0.15 9 or +2.0 +5-4 for 7/2 to 5/2 and +0.36 7 for 9/2 to 7/2 (1970Ba51).

Continued on next page (footnotes at end of table)

$^{40}\text{Ca}(\alpha, p\gamma)$ 1987Fr09, 1972Ba04, 1971Po03 (continued) $\gamma(^{43}\text{Sc})$ (continued)

E(level)	$E_{\gamma}^{\dagger}$	$I_{\gamma}^{\S}$	Comments
2650.5	1806.6		
2669	1816	56	
	2197.0	44	
2762.2	2762.1	100	δ : +0.30 3 for 9/2 to 7/2 (1987Fr09); +0.16 3 for 9/2 to 7/2 and -0.09 5 or -3.8 5 for 5/2 to 7/2 (1970Ba51).
2795.2	1389.1	16	
	1951.3	39	
	2795.1	45	
2810.7	705.0	35 4	$I_{\gamma}(705)/I_{\gamma}(1474)=37/46$ (1987Fr09).
	1473.9	46 5	δ : +0.02 4 for 9/2 (1987Fr09).
	2810.6	19 5	$I_{\gamma}(2811)/I_{\gamma}(1474)=17/46$ (1987Fr09).
2840.0	457.9	18	
	1503.2	44	
	2839.9	38	
2846	2846	100	
2862.7	1212.4	21	
	1982.8	29	
	2711.0	50	
2984.1	1053.5 [@]		$I_{\gamma}(1052)/I_{\gamma}(2104)=22\ 3/34\ 5$ (1970Ba51).
	1647.3	27	$I_{\gamma}(1647)/I_{\gamma}(2104)=35\ 5/34\ 5$ (1970Ba51).
	2104.1	28	
	2140.1	13	
	2832.4	32	I_{γ} : weak γ in 1970Ba51, but the most intense γ from this level in 1987Fr09.
			$I_{\gamma}(2833)/I_{\gamma}(2104)=9\ 4/34\ 5$ (1970Ba51).
2987.6	1157.1 2	100	δ : +0.01 5 for 15/2 to 11/2 and +0.74 +17-14 for 11/2 to 11/2 (1987Fr09), +0.04 +110-21 for 11/2 to 11/2 (1970Ba51).
			E_{γ} : from 1970Sa24.
3123.2	135.8 2	100	E_{γ} : from 1970Sa24.
3139.9	1209.3	100	δ : -0.48 12 or -1.4 4 for 7/2 to 9/2; -0.08 10 or +1.27 23 for 9/2 to 9/2 and +0.41 7 for 11/2 to 9/2 (1970Ba51). But the adopted $J\pi$ for the 3140 level is 13/2+.
3158.8	2278.8	21	
	3007.1	37	
	3158.7	42	
3197.6	2725.6	100	
3264.0	1434.7	4	
	3263.9	96	
3293.7	1363.1	32	
	2116.6	26	
	2413.7	10	
	2449.7	32	
3334	2157	22	
	2490	21	
	2862	26	
	3334	31	
3375.2	1492.9	16	
	1545.9	19	
	1969.1	30	
	2038.3	12	
	3375.1	23	
3451.2	1640.5	73	
	2571.2	27	
3463.3	3311.6	100	
4157	1606	100	

[†] Level-energy differences.[‡] Reported only by 1967Sc08.[§] Values quoted with uncertainties are from 1970Ba51 and/or 1972Ba04, others are from 1987Fr09.[#] From $\gamma(0)$ and RUL (for E2 and M2).[@] Placement of transition in the level scheme is uncertain.

$^{40}\text{Ca}(^6\text{Li}, ^3\text{He})$ 1974Li01

1974Li01: E=34, 36 MeV ^6Li beam of 300–400 nA was produced from the University of Rochester MP Tandem accelerator. Targets of $\approx 75 \mu\text{g}/\text{cm}^2$ ^{40}Ca prepared by evaporating natural calcium onto thin carbon and gold backings. ^3He particles were detected in a spark counter mounted in the focal plane of a magnetic spectrograph, FWHM=50 keV. Measured $\sigma(\theta)$. Deduced levels, J, π , L from DWBA analysis.

1986Pl01: E=156 MeV. Measured (fragment)(γ) coin following breakup, deduced projectile breakup cross section.

All data are from 1974Li01.

 ^{43}Sc Levels

E(level)	J $\pi^{\#}$	L	$\Sigma(\sigma(\text{exp}))/\Sigma(\sigma(\text{DWBA}))^{\S}$
0.0	7/2–	3	0.36
470 $\frac{1}{2}^{\ddagger}$ 30	3/2–		
1180 30	3/2–	1	1.5
1410 $\frac{1}{2}^{\ddagger}$	7/2–		
1810 $\frac{1}{2}^{\dagger}$ 30	3/2–	1	0.67
1830 $\frac{1}{2}^{\dagger}$ 30	11/2–	(5)	0.38
2290 30	5/2–	3	0.85
2620 30	9/2–, 11/2–	5	0.25
2990 30	15/2–	7	0.16
3120 30	(19/2)–	(9)	0.60

$\dagger$ Unresolved doublet. Strength divided by analogy with ^{43}Ti mirror states.

$\ddagger$ Weak peak in spectrum.

$\S$ Sum is over all measured angles.

$\#$ From Adopted Levels.

 $^{42}\text{Ca}(\text{p}, \gamma)$: Resonances 1977Di17, 1969Wa19

1977Di17: E=1.999–2.758 MeV proton beams were produced from the 4 and 3 MV Van de Graaff accelerators, at the Centre de Recherches Nucleaires, Strasbourg, France and at McMaster University respectively, for E>2 MeV; from the 3 MeV Van de Graaff accelerator at the Accelerator Laboratory at University of Helsinki, Finland, for E<2 MeV. Targets of enriched CaCO_3 on tungsten and gold backings. γ -rays were detected by Ge(Li) detectors. Measured γ yields. Deduced energies of resonances.

1969Wa19: E=1.201–2.063 MeV proton beams were produced from the Aerospace Research Laboratories (ARL) 2 MeV Van de Graaff accelerator, FWHM=1 keV. Targets of enriched CaCO_3 on a 10-mil-thick Ag backing. γ -rays were detected by an 8-in-diam by 8-in-long NaI(Tl) detector. Measured γ yields. Deduced energies of resonances, relative resonance strengths.

Others:

1968So11: eight resonances in E(p)(lab)=1345–1424 keV region.

1965Br31, 1966Br21, 1964Br29: E=1013–1421.

 ^{43}Sc Levels

E(level) †	J $\pi^{\@}$	E(p)(LAB) $^{\#}$	Relative intensity §	Comments
5919 $\frac{1}{2}^{\ddagger}$	3/2	1013		E(level): S(p)=4929.8 19 (2012Wa38). E(p)(LAB): from 1965Br31.
5950 $\frac{1}{2}^{\ddagger}$	(3/2, 5/2)	1044		E(p)(LAB): from 1977Di17. Absolute strength=0.67 (1977Di17).
6060 $\frac{1}{2}^{\ddagger}$	(5/2)	1157		E(p)(LAB): from 1965Br31.
6103 $\frac{1}{2}^{\ddagger}$	(3/2–, 5/2+)	1201	105	Absolute strength=0.68 (1977Di17).
6116		1214	7	
6127		1226	13	
6136 $\frac{1}{2}^{\ddagger}$	3/2	1234.8	109	Absolute strength=0.68 14 (1969Wa19).
6143 $\frac{1}{2}^{\ddagger}$	3/2–	1241.9	148	Absolute strength=0.92 18 (1969Wa19).
6146		1245	27	
6151		1250	74	
6174		1274	6	
6182 $\frac{1}{2}^{\ddagger}$	5/2	1282	42	
6185		1285	91	
6190		1290	6	
6198 $\frac{1}{2}^{\ddagger}$	(3/2, 5/2+)	1298	121	Absolute strength=0.74 (1977Di17).
6200		1300	14	

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$^{42}\text{Ca}(\text{p},\gamma)$: Resonances 1977Di17,1969Wa19 (continued)
 ^{43}Sc Levels (continued)

E(level) [†]	$J\pi^{\otimes}$	E(p)(LAB) [#]	Relative intensity [§]	Comments
6210		1310	13	
6211		1312	91	
6217 $\frac{3}{2}^+$	(3/2-, 5/2+)	1318	91	Absolute strength=0.73 (1977Di17).
6228		1329	46	
6242		1343	7	
6247 $\frac{3}{2}^+$	(3/2, 5/2)	1348	116	
6253		1354	36	
6262		1364	13	
6280		1382	59	
6286		1388	4	
6291		1393	34	
6297		1400	71	
6312		1415	10	
6315		1418	22	
6320 $\frac{3}{2}^+$	5/2+	1422.8	202	Absolute strength=1.37 27 (1969Wa19).
6348		1452	70	
6355		1459	13	
6370		1474	20	
6374		1478	85	
6386		1491	3	
6391		1496	13	
6395		1500	85	
6403		1509	53	
6410		1515	15	
6416		1521	50	
6426		1532	49	
6432		1538	61	
6439		1545	128	
6453		1559	22	
6461		1567	9	
6469		1576	56	
6479		1586	53	
6481		1588	53	
6493		1600	5	
6499		1606	92	
6503		1610	38	
6508		1616	34	
6515		1623	23	
6535		1643	100	
6547		1656	6	
6551		1660	49	
6558		1667	24	
6564		1673	41	
6571		1680	21	
6576		1685	58	
6584		1693	31	
6596		1706	75	
6604		1714	195	
6625		1735	99	
6631		1741	51	
6665		1776	63	
6674		1786	47	
6676		1788	64	
6680		1792	77	
6685 $\frac{3}{2}^+$	1/2-	1797	95	
6694		1806	40	
6697 $\frac{3}{2}^+$	5/2	1808.3	255	Absolute strength=2.2 4 (1969Wa19).
6709 $\frac{3}{2}^+$	1/2-	1821	41	
6713		1825	16	
6716		1829	48	
6719		1832	127	
6730		1843	57	
6736		1850	142	

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$^{42}\text{Ca}(\text{p},\gamma)$: Resonances 1977Di17,1969Wa19 (continued) ^{43}Sc Levels (continued)

<u>E(level)[†]</u>	<u>Jπ[@]</u>	<u>E(p)(LAB)[#]</u>	<u>Relative intensity[§]</u>	<u>Comments</u>
6749		1862	33	
6759		1873	111	
6777 $\frac{1}{2}^+$	5 / 2	1891	163	Absolute strength=1.47 29 (1969Wa19).
6786		1900	63	
6794		1908	148	
6801		1916	135	
6814		1929	177	
6830		1945	185	
6834		1949	47	
6846		1962	183	
6856		1972	113	
6861		1977	107	
6871		1987	34	
6877		1993	183	
6881		1997	52	
6889		2006	4	
6901		2018	37	
6906		2023	37	
6913		2030	221	
6920 $\frac{3}{2}^+$	7 / 2	2036.6	301	Absolute strength=3.0 6 (1969Wa19).
6925		2042	30	
6934		2052	110	
6942		2060	190	
6946		2064	87	
6961		2079		
6967		2086		
6971		2090		
6979		2098		
6984		2103		
6991		2110		
6996		2115		
6999		2119		
7004		2123		
7015		2135		
7022		2142		
7025		2145		
7033		2153		
7042		2162		
7051		2171		
7058		2179		
7063		2184		
7072		2193		
7080		2201		
7091		2212		
7095		2217		
7099		2221		
7108		2230		
7118		2240		
7127		2249		
7135		2257		
7141		2264		
7146		2269		
7154		2277		
7159		2282		
7171		2294		
7174		2297		
7177		2300		
7180		2304		
7183		2307		
7198		2322		
7212		2336		
7214		2339		
7223		2348		

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$^{42}\text{Ca}(\text{p},\gamma)$: Resonances 1977Di17,1969Wa19 (continued) ^{43}Sc Levels (continued)

E(level) [†]	$J\pi$ [@]	E(p)(LAB) [#]	Comments
7228		2353	
7240		2365	
7250		2375	
7263		2389	
7269		2395	
7275		2401	
7280		2406	
7285		2411	
7288		2414	
7295		2421	
7302		2428	
7305		2432	
7313		2440	
7344 $\frac{1}{2}^{\pm}$	(3/2-, 5/2)	2471	Absolute strength=3.59 (1977Di17).
7349		2477	
7354		2482	
7366		2494	
7373		2501	
7382		2510	
7388		2517	
7394 $\frac{1}{2}^{\pm}$	(3/2-, 5/2+)	2523	Absolute strength=2.28 (1977Di17).
7402		2531	
7411		2540	
7414		2543	
7418		2547	
7423		2552	
7429		2559	
7433		2563	
7443		2573	
7450		2580	
7466		2596	
7471		2602	
7480		2611	
7483		2614	
7491		2622	
7498		2629	
7501		2632	
7512 $\frac{1}{2}^{\pm}$	(5/2+, 7/2, 9/2-)	2643	Absolute strength=4.20 (1977Di17).
7513		2645	
7518		2650	
7522		2654	
7531		2663	
7536		2668	
7544		2676	
7551		2683	
7559		2692	
7564		2697	
7581 $\frac{1}{2}^{\pm}$	(3/2-, 5/2, 7/2+)	2714	Absolute strength=2.93 (1977Di17).
7592		2725	
7600		2734	
7603		2737	
7607		2741	
7611		2745	
7618		2752	
7624		2758	

[†] From $E_{\text{c.m.}} + S(\text{p})$ where $S(\text{p})=4929.8$ 19 from 2012Wa38 and $E_{\text{c.m.}}$ deduced from $E_{\text{p}}(\text{lab})$ from 1969Wa19 and 1977Di17.

$\frac{1}{2}^{\pm}$ Detailed primary and secondary γ -ray data from this resonance is available. See $^{42}\text{Ca}(\text{p},\gamma)$ E-res dataset.

[§] From 1969Wa19.

[#] Proton energies are from 1969Wa19 from 1201 to ≈ 2000 and from 1977Di17 above 2 MeV. 2 keV uncertainty for energies from 1969Wa19. Uncertainty in proton energies given by 1977Di17 is estimated (by the evaluators) to be about 1 keV, whereas the uncertainty in excitation energies is 2 keV, essentially due to $\Delta S(\text{p})$.

[@] From Adopted Levels.

⁴²Ca(p,γ) E=res 1977Di17,1969Wa19,1965Br31

Gamma decay of resonances in ⁴³Sc.

1977Di17: E=2.00–2.75 MeV proton beams were produced from the 4 and 3 MV Van de Graaff accelerators, at the Centre de Recherches Nucleaires, Strasbourg, France and at McMaster University respectively, for E>2 MeV; from the 3 MeV Van de Graaff accelerator at the Accelerator Laboratory at University of Helsinki, Finland, for E<2 MeV. Targets of enriched CaCO₃ on tungsten and gold backings. γ-rays were detected by Ge(Li) detectors. Measured E_γ, I_γ, γ(θ). Deduced levels, J, π, γ-branchings ratios.

1969Wa19, 1970Ma13 (also 1974Ma39,1971Po03): E=1.1–2.1 MeV, E=11, 9.5 MeV in 1971Po03 and E=1.796 MeV and 1.822 MeV in 1974Ma39. proton beams were produced from the Aerospace Research Laboratories (ARL) 2 MeV Van de Graaff accelerator, FWHM=1 keV. Targets of enriched CaCO₃ on a 10-mil-thick Ag backing. γ-rays were detected by Ge(Li) detectors. Measured E_γ, I_γ, γ(θ), γ(lin pol), γγ, γγ(θ). Deduced levels, J, π, γ-branchings, mixing ratios, T_{1/2} by DSAM. 1970Ma13 report γ-ray data from five resonances at E(p)=1235, 1242, 1423, 1808 and 2037 keV. Lifetime data by Doppler-shift method reported by 1971Po03.

1965Br31 (also 1966Br21,1964Br29,1963Du11): E=1.013–1.421 MeV resonances. Proton beams were produced from the Van de Graaff generator at the Chalmers University of Technology. Target of enriched ⁴²Ca foil on carbon backing. γ-rays were detected by NaI(Tl) detectors. Measured E_γ, I_γ, γγ-coin. Deduced levels, γ-branchings.

Others:

1982Mi06: E=0.63–3.01 MeV. Measured yields.

1979Ch29, 1978Vi02: E=0.66–5.39 MeV. Measured cross sections.

1971Ga40: E=1.424 MeV. Measured E_γ, I_γ, γ(θ).

1968So11: measured cross sections for eight resonances.

⁴³Sc Levels

E(level) [†]	Jπ [‡]	T _{1/2} [§]	Comments
0.0	7/2–		
151.9 5	3/2+		
472.3 4	3/2–		
845.0 5	5/2–	0.146 ps +7–11	T _{1/2} : or 0.16 ps +9–5 (1971Po03).
855.3 4	1/2+		
880.5 4	5/2+		
1158.3 4	3/2+		
1179.0 5	3/2–	0.23 ps +9–6	
1336.3 5	7/2+		
1408 1	7/2–		
1651.2 6	5/2+	0.25 ps +7–6	
1810.3 7	3/2–	16 fs 6	T _{1/2} : or 14 fs +12–9 (1971Po03).
1884.6 6	(5/2, 9/2)–		
1931.2 6	9/2+		
1962.5 5	(3/2, 5/2)–	71 fs 11	T _{1/2} : or 67 fs +24–18 (1971Po03).
2094.3 3	3/2–	0.23 ps +14–7	
2106.4 7	(3/2, 5/2)		
2114.3 9			
2141.9 13	(3/2, 5/2+)	0.17 ps +6–4	Jπ: (7/2) from γγ(θ) (1970Ma13), but γ to 1/2+ excludes 7/2. E(level): from 1965Br31 only.
2200?			
2289.3 8	5/2–		
2335.8 9	5/2–		
2382.9 5	3/2(+)		
2552.0 15	11/2+		
2580.4 8	(5/2)	100 fs +35–24	Jπ: primary transitions from 7/2 and 3/2 resonances.
2670.3 6	3/2–		
2796 2			
2811.2 10			
2840.5 15	(5/2, 7/2)+		
2846.2 15			
2859.7 16			
2875 2	(5/2)+		
2986.7 12	(3/2, 5/2)	53 fs 11	
3160 2			
3261 2	(7/2, 9/2)–		
3290.2 16	7/2–	<3.5 fs	
3327 2			
3331.4 17			
3374 2	(7/2, 9/2)–		
3451.7 10	5/2+	7 fs +7–6	
3463 2	5/2–		
3503 2	7/2–		

Continued on next page (footnotes at end of table)

$^{42}\text{Ca}(\text{p},\gamma)$ E=res 1977Di17,1969Wa19,1965Br31 (continued) **^{43}Sc Levels (continued)**

E(level) [†]	$J\pi^{\ddagger}$	$T_{1/2}^{\S}$	Comments
3645.4 18			
3683 2			
3733.8 18			
3757 2			
3807 1	7/2-	<3.5 fs	
3843 2			
3860 2			
4007 2	(3/2, 5/2)+		
4038 2	7/2-		
4272			E(level): from 1969Wa19.
4371 2	5/2-, 7/2-		$J\pi$: 7/2+ preferred in $\text{p}\gamma(0)$.
4430 2			
4454.7	(5/2 to 9/2)	<3.5 fs	
5919	3/2		E(level): E(p)(lab)=1013.
5950	(3/2, 5/2)		E(level): E(p)(lab)=1045.
6060	(5/2)		E(level): E(p)(lab)=1157.
6103	(3/2-, 5/2+)		E(level): E(p)(lab)=1201.
6136	3/2		E(level): E(p)(lab)=1234.8. $J\pi$: from 1970Ma13.
6143	3/2-		E(level): E(p)(lab)=1241.9. $J\pi$: from 1970Ma13.
6182	5/2		E(level): E(p)(lab)=1282.
6198	(3/2, 5/2+)		E(level): E(p)(lab)=1298.
6217	(3/2-, 5/2+)		E(level): E(p)(lab)=1318.
6247	(3/2, 5/2)		E(level): E(p)(lab)=1348.
6320	5/2+		E(level): E(p)(lab)=1422.8.
6685	1/2-		E(level): E(p)(lab)=1797. $J\pi$: from 1974Ma39.
6696	5/2		14% γ branching proceeds through unidentified transitions. E(level): E(p)(lab)=1808.3.
6709	1/2-		E(level): E(p)(lab)=1821. Very weak resonance (1974Ma39). $J\pi$: from 1974Ma39.
6777	5/2+		E(level): E(p)(lab)=1891.
6919	7/2		E(level): E(p)(lab)=2036.6. $J\pi$: from 1970Ma13.
7344	(3/2-, 5/2)		E(level): E(p)(lab)=2471.
7394	(3/2-, 5/2+)		E(level): E(p)(lab)=2523.
7512	(7/2+)		E(level): E(p)(lab)=2643. $J\pi$: from Adopted Levels. 9/2+ proposed only by 1977Di17, but γ to 3/2+ rules out this assignment.
7581	(3/2-, 5/2, 7/2+)		E(level): E(p)(lab)=2714.

[†] Average of values from 1977Di17, 1969Wa19 and 1965Br31. Above 4454, excitation energies for proton resonances are obtained from $S(\text{p})+E(\text{p})(\text{c.m.})$, where $S(\text{p})=4929.8$ 19 (2012Wa38). Values of $E(\text{p})(\text{lab})$ are given under comments.

[‡] From Adopted Levels up to 5919 keV. For resonances, $J\pi$ assignments are from 1977Di17, unless otherwise stated.

[§] From Doppler-shift method (1971Po03).

 $\gamma(^{43}\text{Sc})$

Data for different resonances are from the following references: from 1977Di17 for $E(\text{p})=1045, 1201, 1299, 1319, 2038, 2471, 2523, 2643$ and 2714; from 1969Wa19 (also 1970Ma13,1974Ma39) for 1235, 1242, 1423, 1796, 1808, 1822, 1891 and 2037; from 1965Br31 (also 1966Br21,1964Br29) for 1013, 1157 and 1346. Data for 1045, 1235, 1242, 1299, and 1423 resonances are also given by 1965Br31.

E(level)	$E_{\gamma}^{\dagger}$	$I_{\gamma}^{\ddagger}$	Mult. [§]	$\delta^{\S}$	Comments
151.9	151.9	100			
472.3	320.3	4 1			
	472.3	100 2			
845.0	845.0	100	M1+E2	+0.18 2	
855.3	383.0	25 2			
	703.3	100 4			
880.5	728.5	100 2	M1+E2	-0.51 7	δ : weighted average of -0.49 8 and -0.64 18 (1970Ma13).

Continued on next page (footnotes at end of table)

⁴²Ca(p,γ) E=res 1977Di17,1969Wa19,1965Br31 (continued)

γ(⁴³Sc) (continued)

E(level)	Eγ [†]	Iγ [‡]	Mult. [§]	δ [§]	Comments
880.5	880.5	2 1			
1158.3	277.8	35 5			δ(Q/D)=+0.23 20, +23 +19-∞ or <-5.7.
	303.0	37 5			δ(Q/D)=+0.19 20 or -2.9 +13-85.
	686.0	4 2			
	1006.3	100 4			δ(Q/D)=-1.3 5 or +1.5 15.
1179.0	298.5	1			
	334.0	17 3			
	706.7	100 8			
	1027.0 [#]				
	1179.0	23 3			
1336.3	455.8	26 2			
	1184.3	100 2			
	1336.3	20 5			
1408	563	16 3			
	936	9 3			
	1408	100 4			
1651.2	492.9	30 3			δ(Q/D)=0.00 20 or -2.4 +12-50.
	770.7	12 3			
	795.9	5 2			
	1499.2	100 5	M1 (+E2)	-0.05 18	
	1651.2	20 3			
1810.3	631.3	100 13			
	955.0	41 10			
	1338.0	90 10			
	1658.3	26 8			
1884.6	1004.1	21			
	1039.6	16			
	1884.6	100	D+Q		δ(Q/D)=-0.4 +2-11 for 9/2; +(1.1 +13-6) for 5/2.
1931.2	594.9	19 2	D+Q	-0.14 6	A ₂ =+0.63 11, A ₄ =+0.01 12 (1977Di17).
	1050.7	100 4	Q		A ₂ =-0.38 6, A ₄ =+0.30 6 (1977Di17).
	1931.2	1			
1962.5	783.5	15 2			δ(Q/D)=-0.04 25 or +(1.5 +∞-10).
	804.2	4 1			
	1490.2	100 2			
	1962.5				
2094.3	915.3	100 9			δ(Q/D)=0.00 10, +(3.7 +25-10) or -10 +4-48.
	1213.8	30 6			
	1239.0	55 6			
	1249.3	33 6			
	1622.0	33 9			
	1942.3	52 9			
2106.4	948.1	30 4			
	1225.9	100 6			
2114.3	956.0	79 9			
	1962.3	100 13			
2141.9	490.7	38			Iγ: from Fig. 1 of 1977Di17.
	962.9	6 3			
	983.6	15 6			
	1261.4	100 9			δ(Q/D)=+0.27 10 or -23 +12-∞.
	1286.6	12 6			
	1669.6	50 6			
	1989.9	74 6			
	2141.8 [#]		D (+Q)	0.00 4	Iγ: 102 (1969Wa19). γ not reported by 1977Di17.
2200?	2200 [#]				
2289.3	2289.2	100			
2335.8	2335.7	100			
2382.9	731.7	100			
2552.0	620.8	100 8			
	1215.7	67 7			
2580.4	617.9 [#]				Iγ: 1969Wa19 report only the 617 and 1401 γs from 2580 level, with Iγ(617)/Iγ(1401)=0.33.
	1401.4 [#]				δ(Q/D)=+0.11 10 or -5.7 +20-80.
	1422.1	52 10			

Continued on next page (footnotes at end of table)

⁴²Ca(p,γ) E=res 1977Di17,1969Wa19,1965Br31 (continued)

γ(⁴³Sc) (continued)

E(level)	Eγ [†]	Iγ [‡]	Mult. [§]	δ [§]	Comments
2580.4	1699.9	40 8			
	2428.3	100 13			
2670.3	1262.3 [#]				Iγ: 1969Wa19 report 1260 and 1492 γs from 2670 level, with Iγ(1260)/Iγ(1492)=0.33. Iγ: other: 100 (1969Wa19).
	1491.3	16 4			
	1789.8	43 8			
	1815.0	100 4			
	2197.9	45 6			
2796	1951	100 9			
	2644	33 5			
2811.2	1474.9	100 10			
	2811.1	100 10			
2840.5	1960.0	43 9			
	2840.4	100 7			
2846.2	2846.1	100			
2859.7	1208.5	14 5			
	1680.7	16 5			
	1701.4	23 7			
	1979.2	100 5			
	2707.6	75 7			
2875	2723				From intensity balance, this γ-ray accounts for 80% of the total intensity, other 20% intensity is unaccounted for.
2986.7	1650.4	16			
	1807.7	34 8			
	2106.1	71 5			δ(Q/D)=-0.95 50 for 5/2; +0.13 11 or -11 +7-∞ for 3/2.
	2141.6	58 8			
	2834.6	100 8			δ(Q/D)=+(0.66 +60-30) for 5/2; 0.00 9 or +(4.5 +30-13) for 3/2.
3160	2279				From intensity balance, this γ-ray accounts for 25% of the total intensity, other 75% intensity is unaccounted for.
3261	3261				From intensity balance, this γ-ray accounts for 60% of the total intensity, other 40% intensity is unaccounted for.
3290.2	1479.9	21 5			
	2111.1	100 12			
	2409.6	21 7			
	2445.1	91 9			
	3290 [#]				This is the only γ reported from 3290 level by 1969Wa19.
3327	3327				From intensity balance, this γ-ray accounts for 70% of the total intensity, other 30% intensity is unaccounted for.
3331.4	1368.9	4 2			
	1521.1	13 4			
	2152.3	100 4			
	2173.0	44 4			
	2486.3	29 6			
	2859.0	19 4			
3374	3374				From intensity balance, this γ-ray accounts for 50% of the total intensity, other 50% intensity is unaccounted for.
3451.7	2571.1	100 7			
	2606.6	45 7			
	3299.6	55 7			
	3451.6	27 9			Iγ: 1969Wa19 report this as the only γ from 3452 level.
3463	2582	37 4			
	3311	100 7			
3503	2658	100 10			
	3503	100 10			
3645.4	1682.9	34 11			
	1994.2	66 13			
	2466.3	100 16			
	2764.8	63 13			
3683	2803	25 4			
	2838	56 5			
	3531	100 11			
3733.8	1444.5	31			
	2325.7	83			

Continued on next page (footnotes at end of table)

⁴²Ca(p,γ) E=res 1977Di17,1969Wa19,1965Br31 (continued)

γ(⁴³Sc) (continued)

E(level)	Eγ [†]	Iγ [‡]	Mult. [§]	δ [§]	Comments
3733.8	2888.7	100			
3757	3605	100 10			
	3757	43 7			
3807	2471	24 6			
	2926	100 5			A ₂ =-0.36 9, A ₄ =+0.11 10 (1977Di17). δ(Q/D)=0.00 10 for 7/2 to 5/2 transition.
	3335	35 8			
	3807				This is the only γ reported by 1969Wa19 from the 3807 level.
3843	2998				From intensity balance, this γ-ray accounts for 40% of the total intensity, other 60% intensity is unaccounted for.
3860	3708				From intensity balance, this γ-ray accounts for 80% of the total intensity, other 20% intensity is unaccounted for.
4007	3126	83 20			
	3152	100 20			
	3535	50 13			
	3855	100 17			
4038	2107	100 13			
	3566	67 15			
4371	2265	37 7			
	2720	32 10			
	2963	49 12			
	3035	100 10			
	3490	27 7			
4430	3251	100 15			
	3272	75 13			
	3549	75 10			
4454.7	4454.5	100			δ(Q/D)=+0.13 5 for 9/2; -0.05 5 or -5.7 +14-35 for 5/2.
5919	2629	33			
	3249	33			
	3338	33			
	3536	67			
	3719 [#]				
	4268	67			A ₂ =-0.25 (1966Br21).
	4740	33			A ₂ =-0.43 (1966Br21).
	4760	67			A ₂ =-0.33 (1966Br21).
	5038	67			A ₂ =-0.43 (1966Br21).
	5074	100			A ₂ =-0.77 (1966Br21).
	5446	67			A ₂ =-0.15 (1966Br21).
	5767	100			A ₂ =-0.28 (1966Br21).
5950	2143 [#]				
	2619	62			
	2660	19			Iγ: 1965Br31 report this as the strongest γ-ray from this level.
	2964 [#]				
	3369	14			
	3615	5			
	3661	5			
	3808	10			
	3836	5			
	3856	10			
	3987	33			
	4139	5			
	4299	67			
	4771	100			
	4791	14			
	5094	43			Eγ: 5105 from level difference in 1965Br31. I(5105γ)/I(4771γ)=0.33.
	5477	43			
	5798	43			Eγ: 5805 from level difference in 1965Br31. I(5805γ)/I(4771γ)=1.
6060	6060				
6103	2260	1.6			
	2651	10			
	2943	1.6			
	3116	1.6			
	3257	1.6			

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$^{42}\text{Ca}(\text{p},\gamma)$ E=res 1977Di17,1969Wa19,1965Br31 (continued) $\gamma(^{43}\text{Sc})$ (continued)

E(level)	$E\gamma^{\dagger}$	$I\gamma^{\ddagger}$	Mult. [§]	$\delta^{\S}$	Comments
6103	3262	<1.6			
	3961	13			
	3996	5			
	4695	5			
	4766	8			
	4924	3			
	5247	1.6			
	5258	3			
	5630	1.6			
	5951	100			
	6103	5			
6136	2329 [#]				
	2846 [#]				
	3150 [#]	30			
	3466 [#]	15			
	3555	35			$\delta(\text{Q/D})=-0.14$ 7 or -2.6 $+5-7$ for $J\pi(\text{res})=3/2$ (1970Ma13).
	3994	24			
	4041	71			$\delta(\text{Q/D})=+0.07$ 5 or $+2.7$ $+6-10$ for $J\pi(\text{res})=3/2$ (1970Ma13).
	4173	100			$\delta(\text{Q/D})=+0.14$ 10 or -19 $+13-\infty$ for $J\pi(\text{res})=3/2$ (1970Ma13).
	4485	35			$\delta(\text{Q/D})=+0.36$ 2 or $+7.6$ $+48-\infty$ for $J\pi(\text{res})=3/2$ (1970Ma13).
	4957	65			$\delta(\text{Q/D})=-0.36$ 6 or -9.5 $+30-70$ for $J\pi(\text{res})=3/2$ (1970Ma13).
	4977	53			$\delta(\text{Q/D})=-0.05$ 3 or $+4.7$ $+7-20$ for $J\pi(\text{res})=3/2$ (1970Ma13).
	5255	41			$\delta(\text{Q/D})=-0.05$ 3 for $J\pi(\text{res})=3/2$ (1970Ma13).
	5280	18			
	5291	24			
	5663	24			$\delta(\text{Q/D})=-0.36$ 2 or -7.6 $+20-38$ for $J\pi(\text{res})=3/2$ (1970Ma13).
	5984	100			$\delta(\text{Q/D})=0.00$ 2 or $+3.7$ 5 for $J\pi(\text{res})=3/2$ (1970Ma13).
6143	2336	21			
	2853	21			$\delta(\text{Q/D})=0.00$ 6 or $+3.7$ $+8-15$ for $J\pi(\text{res})=3/2$ and $J\pi(3290)=3/2$; -0.81 20 for $J\pi(3290)=5/2$ (1970Ma13).
	3156	37			$\delta(\text{Q/D})=+0.11$ 12 or $+2.7$ $+5-13$ for $J\pi(\text{res})=3/2$ and $J\pi(2987)=3/2$; -0.78 40 for $J\pi(2987)=5/2$ (1970Ma13).
	3473	32			
	4048	32			$\delta(\text{Q/D})=+0.13$ 7 or $+2.4$ 5 for $J\pi(\text{res})=3/2$ (1970Ma13).
	4180	26			$\delta(\text{Q/D})=+0.06$ 5 for $J\pi(\text{res})=3/2$ (1970Ma13).
	4332	11			
	4964	68			$\delta(\text{Q/D})=-0.17$ 4 or $+19$ $+8-28$ for $J\pi(\text{res})=3/2$ (1970Ma13).
	4984	16			
	5262	11			
	5287	100			
	5298	53			
	5670	16			$\delta(\text{Q/D})=0.00$ 3 or $+3.7$ $+5-8$ for $J\pi(\text{res})=3/2$ (1970Ma13).
	5991	74			$\delta(\text{Q/D})=-0.10$ 3 or $+8.8$ $+25-65$ for $J\pi(\text{res})=3/2$ (1970Ma13).
	6143	11			
6182	6032				
6198	2464	16			
	3862	20			
	4056	16			
	4103	52			
	4235	12			
	4547	48			
	5317	100			
	5342	60			
	5353	12			
	6046	64			
6217	2357	2			
	2572	6			
	2765	6			
	3230	8			
	3357	12			
	3547	10			
	4075	4			
	4110	2			

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⁴²Ca(p,γ) E=res 1977Di17,1969Wa19,1965Br31 (continued)

γ(⁴³Sc) (continued)

E(level)	Eγ [†]	Iγ [‡]	Mult. [§]	δ [§]	Comments
6217	4122	4			
	4406	6			
	4809	2			
	4880	<2			
	5336	6			
	5361	100			
	5744	16			
	6065	8			
	6217	8			
6247	2957 [#]				
	4047 [#]				
	4105	50			
	4152	17			
	4284	33			
	4596 [#]				
	5068	17			
	5366	33			
	5402	83			
	6095	100			
6320	2513	11			
	2868	5			
	3333	11			δ(Q/D)=-0.02 4 for Jπ(2987)=3/2 and -0.81 12 for Jπ(2987)=5/2 (1970Ma13).
	3739	3			
	3937	2			δ(Q/D)=+0.45 8 or +2.7 +5-8 for Jπ(2383)=7/2 and -0.18 8 for Jπ(2383)=3/2 (1970Ma13).
	4178	10	D+Q	+0.07 6	
	4669	2			
	4983	3			
	5141	6	D+Q	0.00 3	
	5439	10	D+Q	+0.14 5	
	5464	10			δ(Q/D)=+0.01 3 or -3.1 5.
	5475	8			
	6168	100	D+Q	+0.03 3	
6685	4104	13			
	4590	79			
	4722	42			
	5506	38			
	5804	33			
	5829	25			
	6212	29			
	6533	100			
6696	3013	5			
	3369 [#]	5			
	4313	9			δ(Q/D)=-0.13 10 or -4.2 +10-15 for Jπ(2383)=7/2 and +0.20 10 for Jπ(2383)=3/2.
	4733	5	D+Q	-0.47 8	
	5044	11	D+Q	-0.07 7	
	5359	11			δ(Q/D)=-0.14 6 or -23 +∞-12.
	5517	7			
	5537	7			
	5815	32	D+Q	+0.03 3	
	5851	7	D+Q	-0.27 10	
	6223	2	D+Q	+0.22 5	
	6544	100	D+Q	-0.14 4	
	6695	27	D+Q	+0.02 4	
6709	3722 [#]	25			
	4614 [#]	100			
	4747 [#]	19			
	6236 [#]	8			
	6557 [#]	17			
6777	2322	64			
	3790	45			

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⁴²Ca(p,γ) E=res 1977Di17,1969Wa19,1965Br31 (continued)

γ(⁴³Sc) (continued)

E(level)	Eγ [†]	Iγ [‡]	Comments
6777	4196	55	
	4394	36	
	4635	82	
	5125	91	
	5369	18	
	5440	27	
	5598	100	
	5896	91	
	5921	45	
	5932	82	
	6304	91	
	6625	82	
6919	2464	13	δ(Q/D)=+0.18 6 for Jπ(res)=7/2 and Jπ(4455)=9/2; -0.04 6 for Jπ(4455)=5/2 (1970Ma13).
	2647 [#]	5	γ from 1969Wa19 only.
	3076	3	
	3592	6	
	3658	6	
	4044	3	
	4123	3	
	4338 [#]	3	δ(Q/D)=+0.32 10 for Jπ(res)=7/2 (1970Ma13).
	5034	5	δ(Q/D)=-0.18 16 or -5.7 +20-60 for Jπ(res)=7/2 and Jπ(1885)=9/2; +0.22 16 for Jπ(1885)=5/2 (1970Ma13).
	5511	5	δ(Q/D)=-0.04 4 for Jπ(res)=7/2 (1970Ma13).
	6037	3	
	6074	100	δ(Q/D)=0.00 2 for Jπ(res)=7/2 (1970Ma13).
	6446 [#]	3	δ(Q/D)=+0.04 4 for Jπ(res)=7/2 (1970Ma13).
7344	6917	11	δ(Q/D)=-0.29 8 for Jπ(res)=7/2 (1970Ma13).
	3484	13	
	3537	39	
	3661	10	
	3698	10	
	4184	19	
	5229	6	
	5692	19	
	6007	6	
	6165	6	
	6185	6	
	6463	100	
	7191	55	
7394	7343	32	
	2964	20	
	3387	28	
	3637	8	
	3931	12	
	3942	12	
	4519	8	
	4534	8	
	4598	4	
	4813	4	
	5011	4	
	5252	4	
	5279	28	
	5583	8	
	5742	8	
	5986	4	
	6057	4	
	6215	16	
	6235	40	
	6513	32	
	6538	20	
	6548	16	
	6921	8	
	7241	100	

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⁴²Ca(p,γ) E=res 1977Di17,1969Wa19,1965Br31 (continued)

γ(⁴³Sc) (continued)

E(level)	Eγ [†]	Iγ [‡]	Comments
7394	7393	4	
7512	3141	12	A ₂ =+0.28 5, A ₄ =-0.02 5 (1977Di17). δ(Q/D)=+0.31 6 for 9/2 to 7/2 transition.
	3474	3	A ₂ =-0.22 12, A ₄ =+0.04 13 (1977Di17). δ(Q/D)=+0.05 8 for 9/2 to 7/2; -0.70 22 for 9/2 to 9/2; and +0.02 11 for 9/2 to 11/2.
	3705	10	A ₂ =-0.31 10, A ₄ =-0.18 10 (1977Di17). δ(Q/D)=-0.05 6 for 9/2 to 7/2 transition.
	4671	3	
	4701	3	
	4960	3	
	5580	100	A ₂ =+0.38 4, A ₄ =-0.14 4 (1977Di17). δ(Q/D)=+0.90 14 or -0.20 7 for 9/2 to 9/2 transition.
	5627	3	
	6353	5	
	6666	3	
	7511	22	A ₂ =-0.20 9, A ₄ =+0.01 9 (1977Di17). δ(Q/D)=+0.05 7 for 9/2 to 7/2 transition.
7581	3151	3	
	3898	18	
	4078	5	
	4129	8	
	4207	5	
	4721	3	
	5439	13	
	6700	100	
	7428	93	
	7580	5	

[†] Level-energy differences.

[‡] From average of data from 1977Di17, 1969Wa19 and 1965Br31.

[§] From γ(θ), γγ(θ), γ(lin pol) data of 1970Ma13, unless otherwise stated.

[#] Placement of transition in the level scheme is uncertain.

⁴²Ca(p,p): Resonances 1976Wi16,1974Ma39

S(p)=4929.8 19 (2012Wa38).

1976Wi16: E=1.2-3.0 MeV proton beams were produced from the TUNL 3 MV Van de Graaff accelerator, FWHM=325 eV.

Targets of enriched CaCO₃ (94.42% ⁴²Ca) on carbon backings. Elastically scattered protons were detected by surface barrier detectors. Measured σ(E,θ). Deduced resonances, levels, J, Γ_p.

1974Ma39: E=1.20-3.23 MeV proton beams were produced from the Aerospace Research Laboratories (ARL) 8-MeV tandem accelerator, FWHM=200 eV. Targets of enriched CaCO₃ on carbon backings. Scattered protons were detected by surface barrier detectors. Measured σ(E,θ). Deduced resonances, levels, J, π, Γ.

1968Br27: E=1.24-1.82 MeV. Deduced resonances at 1240, 1792, 1802, 1817.

⁴³Sc Levels

E(level) [†]	Jπ ^{‡§}	Γ _p [†]	E(p) (lab) [†]	γ _p ² keV [†]	Comments
6149.5	3/2-	125 eV 15	1248.7	129.90	E(p)=1241.9 5, Γ _p =145 eV 5, γ _p ² =145 keV (1974Ma39).
6222.9	1/2+	50 eV 10	1323.9	10.99	
6417.6	1/2+	15 eV 5	1523.2	1.10	
6440.6	1/2+	1.5 eV 5	1546.8	0.99	
6510.7	1/2+	15 eV 5	1618.5	0.72	
6561.4	1/2-	180 eV 20	1670.4	18.52	
6564.1	1/2+	15 eV 5	1673.2	0.57	
6570.1	1/2+	10 eV 5	1679.4	0.37	
6630.0	1/2-	5 eV 3	1740.7	40.3	
6651.0	1/2+	175 eV 20	1762.2	4.72	
6677.4	(1/2-)	10 eV 5	1789.2	0.68	
6684.4	1/2+	15 eV 5	1796.4	0.36	

Continued on next page (footnotes at end of table)

⁴²Ca(p,p): Resonances 1976Wi16,1974Ma39 (continued)

⁴³Sc Levels (continued)

E(level) [†]	Jπ ^{†§}	Γ _p [†]	E(p) (lab) [†]	γ _p ² keV [†]	Comments
6685.3	3/2-	65 eV 10	1797.3	4.01	E(p)=1797 1, Jπ=1/2-, Γ _p =120 eV 10, γ _p ² =145 keV (1974Ma39).
6694.8	1/2-	45 eV 10	1807.0	2.68	E(p)=1803.3 5, Γ _p =75 eV 5, γ _p ² =7.8 keV (1974Ma39).
6709.2	1/2-	900 eV 90	1821.8	50.71	
6709.5	1/2-	300 eV 30	1822.1	16.88	E(p)=1822 1, Γ _p =1450 eV 50, γ _p ² =135 keV (1974Ma39).
6736.6	3/2-	45 eV 10	1849.8	2.29	
6795.1	1/2-	500 eV 50	1909.7	20.60	
6795.4	1/2-	500 eV 50	1910.0	20.58	
6815.3	1/2+	30 eV 7	1930.4	0.46	
6827.0	3/2-	40 eV 10	1942.4	1.48	
6849.7	(3/2+)	10 eV 5	1965.6	1.96	
6850.8	1/2-	25 eV 7	1966.8	0.85	
6853.9	(3/2+)	10 eV 5	1969.9	1.93	
6855.0	1/2-	22 eV 7	1971.0	0.74	
6859.0	(3/2+)	13 eV 5	1975.1	2.47	
6868.2	1/2+	45 eV 10	1984.6	0.58	
6880.1	1/2+	120 eV 15	1996.7	1.50	
6899.7	1/2-	190 eV 20	2016.8	5.52	E(p)=2021 1, Γ _p =310 eV 10, γ _p ² =13.7 keV (1974Ma39).
6912.4	1/2+	240 eV 25	2029.8	2.73	E(p)=2033 1, Γ _p =280 eV 10, γ _p ² =5.3 keV (1974Ma39).
6936.4	1/2+	150 eV 15	2054.4	1.59	E(p)=2059 1, Γ _p =205 eV 5, γ _p ² =4 keV (1974Ma39).
6943.7	1/2-	165 eV 15	2061.9	4.19	E(p)=2066 1, Γ _p =214 eV 5, γ _p ² =9.6 keV (1974Ma39).
6966.0	(3/2+)	15 eV 5	2084.7	1.95	
6978.9	(3/2+)	20 eV 5	2097.9	2.49	
6983.6	1/2-	8 eV 5	2102.7	0.18	
7013.7	(3/2-)	15 eV 5	2133.5	0.31	
7024.7	(3/2+)	15 eV 5	2144.8	1.61	
7027.7	1/2-	150 eV 15	2147.8	2.97	E(p)=2151 1, Γ _p =224 eV 5, γ _p ² =7.2 keV (1974Ma39).
7032.1	1/2+	10 eV 5	2152.4	0.08	
7037.2	3/2-	35 eV 7	2157.6	0.67	
7046.4	(5/2+)	25 eV 7	2167.0	2.50	
7067.5	1/2+	800 eV 80	2188.6	5.99	
7074.9	1/2-	25 eV 7	2196.2	0.43	
7085.6	1/2-	300 eV 30	2207.1	5.05	
7094.4	3/2-	75 eV 15	2216.1	1.23	
7099.1	1/2+	50 eV 10	2221.0	0.35	
7116.8	1/2-	2.50 keV 25	2239.1	38.71	
7123.4	(3/2+)	10 eV 5	2245.8	0.79	
7125.0	1/2+	350 eV 35	2247.5	2.28	
7132.3	(3/2+)	10 eV 5	2254.9	0.77	
7138.0	3/2-	600 eV 60	2260.8	8.80	
7140.2	1/2+	600 eV 60	2263.0	3.77	
7150.5	(3/2+)	25 eV 7	2273.6	1.82	
7155.8	3/2-	50 eV 10	2279.0	0.70	
7170.2	1/2-	600 eV 60	2293.7	8.10	
7176.5	(5/2-)	5 eV 3	2300.2	3.37	
7185.2	(3/2+)	10 eV 5	2309.1	0.66	
7211.0	(1/2-)	10 eV 5	2335.5	0.12	
7215.3	(1/2+)	5 eV 3	2339.8	0.03	
7222.9	3/2+	35 eV 7	2347.7	2.07	
7227.1	(3/2+)	10 eV 5	2352.0	0.58	
7231.2	1/2-	500 eV 50	2356.2	5.81	
7240.8	(3/2+)	10 eV 5	2366.0	0.56	
7247.5	1/2-	150 eV 15	2372.9	1.68	
7251.0	(3/2+)	15 eV 5	2376.5	0.82	
7255.4	1/2+	70 eV 10	2381.0	0.34	
7256.8	3/2-	30 eV 7	2382.4	0.33	
7266.3	(3/2+)	20 eV 5	2392.1	1.05	
7281.0	(1/2-)	10 eV 5	2407.2	0.10	
7289.8	3/2+	35 eV 7	2416.2	1.73	
7290.9	(3/2+)	25 eV 7	2417.3	1.23	
7307.6	3/2-	40 eV 10	2434.4	0.39	
7309.1	1/2-	1.00 keV 10	2435.9	9.69	
7311.2	(3/2+)	5 eV 3	2438.1	0.23	

Continued on next page (footnotes at end of table)

⁴²Ca(p,p): Resonances 1976Wi16,1974Ma39 (continued)

⁴³Sc Levels (continued)

E(level) [†]	Jπ ^{‡§}	Γ _p [†]	E(p) (lab) [†]	γ _p ² keV [†]	Comments
7315.8	1/2+	25 eV 7	2442.8	0.11	
7326.9	1/2-	3.00 keV 30	2454.2	27.92	E(p)=2460 1, Γ _p =2.92 keV 5, γ _p ² =42.2 keV (1974Ma39).
7329.5	(3/2+)	20 eV 5	2456.8	0.89	
7339.4	1/2+	600 eV 60	2467.0	2.46	E(p)=2473 1, Γ _p =540 eV 20, γ _p ² =4 keV (1974Ma39).
7363.5	1/2+	100 eV 15	2493.7	0.39	E(p)=2500 2, Γ _p =130 eV 10, γ _p ² =0.9 keV (1974Ma39).
7365.1	1/2-	90 eV 15	2493.3	0.77	
7369.7	1/2-	700 eV 70	2498.0	5.93	E(p)=2504 2, Γ _p =676 eV 5, γ _p ² =8.6 keV (1974Ma39).
7370.8	1/2-	40 eV 10	2499.1	0.34	
7378.5	1/2+	80 eV 15	2507.0	0.30	E(p)=2514 2, Γ _p =85 eV 5, γ _p ² =0.5 keV (1974Ma39).
7385.5	(5/2-)	5 eV 3	2514.2	0.77	
7390.3	1/2+	300 eV 30	2519.1	1.12	
7395.7	3/2+	40 eV 10	2524.6	1.50	
7412.4	1/2-	225 eV 25	2541.7	1.74	
7414.5	(3/2+)	5 eV 3	2543.9	0.18	
7419.4	3/2-	110 eV 15	2548.9	0.84	
7424.7	5/2+	30 eV 7	2554.3	1.05	
7439.9	5/2+	50 eV 10	2569.9	1.69	
7445.0	1/2+	400 eV 40	2575.1	1.35	
7448.4	1/2-	20 eV 5	2578.6	0.14	
7461.7	(3/2+)	15 eV 5	2592.2	0.48	
7463.7	3/2-	20 eV 5	2594.2	0.14	
7476.6	1/2-	500 eV 50	2607.4	3.40	
7477.1	(5/2+)	25 eV 7	2608.0	0.77	
7478.6	3/2-	30 eV 7	2609.5	0.20	
7483.8	(5/2-)	2 eV 2	2614.8	0.54	
7492.0	1/2+	175 eV 20	2623.2	0.54	
7502.0	(5/2-)	5 eV 3	2633.4	1.28	
7508.5	3/2-	70 eV 10	2640.1	0.45	
7512.1	1/2-	1.00 keV 10	2643.8	6.34	
7517.6	(5/2+)	15 eV 5	2649.4	0.42	
7527.5	(3/2-)	15 eV 5	2659.6	0.09	
7539.1	3/2-	550 eV 55	2671.4	3.31	
7540.0	1/2+	15 eV 5	2672.3	0.04	
7557.1	(5/2+)	20 eV 5	2689.9	0.51	
7560.2	3/2-	150 eV 15	2693.0	0.87	
7564.1	(3/2+)	15 eV 5	2697.0	0.38	
7570.1	1/2+	400 eV 40	2703.2	1.08	E(p)=2715 2, Γ _p =380 eV 30, γ _p ² =1.1 keV (1974Ma39).
7586.6	1/2-	125 eV 15	2720.1	0.69	E(p)=2727 2, Γ _p =150 eV 10, γ _p ² =1.2 keV (1974Ma39).
7595.5	(3/2+)	15 eV 5	2729.2	0.35	
7596.9	1/2-	400 eV 40	2730.6	2.16	E(p)=2737 2, Γ _p =550 eV 20, γ _p ² =4.5 keV (1974Ma39).
7599.6	1/2+	80 eV 15	2733.4	0.21	E(p)=2740 2, Γ _p =90 eV 10, γ _p ² =0.4 keV (1974Ma39).
7604.5	(3/2+)	15 eV 5	2738.4	0.35	
7614.2	3/2-	20 eV 5	2748.3	0.10	
7615.6	(1/2-)	10 eV 5	2749.7	0.05	
7619.5	1/2-	3.50 keV 35	2753.7	18.16	E(p)=2761 2, Γ _p =770 eV 40, γ _p ² =5.6 keV (1974Ma39).
7620.8	(3/2+)	10 eV 5	2755.1	0.22	
7625.8	(3/2+)	15 eV 5	2760.2	0.33	E(p)=2768 2, Γ _p =30 eV 10, γ _p ² =1 keV (1974Ma39).
7627.1	(5/2+)	20 eV 5	2761.6	0.44	
7630.7	3/2-	185 eV 20	2765.2	0.94	E(p)=2772 2, Jπ=1/2-, Γ _p =320 eV 10, γ _p ² =2.3 keV (1974Ma39).
7639.4	3/2-	20 eV 5	2774.1	0.10	
7644.1	(3/2+)	15 eV 5	2778.9	0.32	
7646.1	(3/2+)	15 eV 5	2781.0	0.32	
7659.6	3/2-	50 eV 10	2794.5	0.24	
7666.6	1/2+	500 eV 50	2802.0	1.17	
7668.0	1/2+	600 eV 60	2803.4	1.40	
7675.7	3/2-	50 eV 10	2811.3	0.24	
7683.6	(5/2-)	18 eV 5	2819.4	2.90	
7693.2	1/2-	60 eV 10	2829.2	0.27	
7703.3	(5/2+)	8 eV 5	2839.5	0.15	
7708.3	1/2+	100 eV 10	2844.7	0.22	
7711.1	1/2-	700 eV 70	2847.5	3.10	
7714.8	(5/2-)	15 eV 5	2851.3	2.24	

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$^{42}\text{Ca}(\text{p},\text{p})$: Resonances 1976Wi16,1974Ma39 (continued) **^{43}Sc Levels (continued)**

$E(\text{level})^\dagger$	$J\pi^\ddagger$	$\Gamma_p^\ddagger$	$E(\text{p}) (\text{lab})^\dagger$	$\gamma_p^2 \text{ keV}^\ddagger$
7721.7	1/2-	25 eV 7	2858.4	0.11
7733.7	(5/2+)	20 eV 5	2870.7	0.35
7738.3	1/2-	75 eV 15	2875.4	0.32
7738.5	1/2+	25 eV 7	2875.6	0.05
7744.3	3/2-	700 eV 70	2881.5	2.93
7747.3	1/2-	40 eV 10	2884.6	0.17
7751.4	1/2-	25 eV 7	2888.8	0.10
7754.0	(5/2+)	25 eV 7	2891.4	0.42
7760.9	(5/2+)	25 eV 7	2898.5	0.42
7761.3	1/2-	35 eV 7	2898.9	0.14
7769.4	1/2+	650 eV 65	2907.2	1.32
7784.7	(3/2+)	15 eV 5	2922.9	0.24
7785.3	(5/2-)	5 eV 3	2923.5	0.63
7797.5	(5/2+)	30 eV 7	2936.0	0.47
7803.6	1/2+	125 eV 15	2942.2	0.24
7807.2	3/2-	115 eV 15	2945.9	0.44
7807.7	1/2-	35 eV 7	2946.4	0.13
7810.8	(3/2+)	5 eV 3	2949.6	0.08
7815.6	(5/2+)	10 eV 5	2954.5	0.15
7818.6	1/2+	200 eV 20	2957.6	0.38
7819.0	1/2+	80 eV 15	2958.0	0.15
7820.5	(5/2+)	20 eV 5	2959.5	0.30
7829.6	1/2-	25 eV 7	2968.8	0.09
7830.3	3/2-	240 eV 25	2969.6	0.88
7832.0	(5/2-)	3 eV 3	2971.3	0.34
7832.8	(3/2+)	30 eV 7	2972.1	0.44
7836.2	(5/2-)	8 eV 5	2975.6	0.90
7838.0	(3/2+)	25 eV 7	2977.4	0.36
7841.4	1/2+	200 eV 20	2980.9	0.37
7844.2	3/2-	120 eV 15	2983.3	0.43
7850.5	3/2-	75 eV 15	2990.2	0.27
7859.2	1/2-	225 eV 25	2999.1	0.79
7859.8	1/2-	30 eV 7	2999.8	0.11
7861.6	3/2+	20 eV 5	3001.6	0.28
7868.5	3/2-	50 eV 10	3008.7	0.17
7919 $\frac{1}{2}$	3/2+, (5/2+) $\frac{1}{2}$	150 eV $\frac{1}{2}$ 20	3060 $\frac{1}{2}$	7 $\frac{1}{2}$
7926 $\frac{1}{2}$	1/2-, (3/2-) $\frac{1}{2}$	420 eV $\frac{1}{2}$ 50	3067 $\frac{1}{2}$	2 $\frac{1}{2}$
7933 $\frac{1}{2}$	1/2+ $\frac{1}{2}$	270 eV $\frac{1}{2}$ 20	3074 $\frac{1}{2}$	0.6 $\frac{1}{2}$
7941 $\frac{1}{2}$	1/2+ $\frac{1}{2}$	1.36 keV $\frac{1}{2}$ 6	3083 $\frac{1}{2}$	3.1 $\frac{1}{2}$
7954 $\frac{1}{2}$	1/2-, (3/2-) $\frac{1}{2}$	160 eV $\frac{1}{2}$ 10	3096 $\frac{1}{2}$	0.7 $\frac{1}{2}$
7961 $\frac{1}{2}$	1/2-, (3/2-) $\frac{1}{2}$	150 eV $\frac{1}{2}$ 10	3103 $\frac{1}{2}$	0.6 $\frac{1}{2}$
8014 $\frac{1}{2}$	1/2- $\frac{1}{2}$	260 eV $\frac{1}{2}$ 10	3157 $\frac{1}{2}$	1 $\frac{1}{2}$
8019 $\frac{1}{2}$	3/2+, (5/2+) $\frac{1}{2}$	30 eV $\frac{1}{2}$ 10	3163 $\frac{1}{2}$	0.4 $\frac{1}{2}$
8034 $\frac{1}{2}$	3/2+, (5/2+) $\frac{1}{2}$	80 eV $\frac{1}{2}$ 10	3178 $\frac{1}{2}$	1 $\frac{1}{2}$
8045 $\frac{1}{2}$	3/2+, (5/2+) $\frac{1}{2}$	40 eV $\frac{1}{2}$ 10	3189 $\frac{1}{2}$	0.5 $\frac{1}{2}$
8048 $\frac{1}{2}$	1/2+ $\frac{1}{2}$	140 eV $\frac{1}{2}$ 10	3192 $\frac{1}{2}$	0.3 $\frac{1}{2}$
8061 $\frac{1}{2}$	1/2- $\frac{1}{2}$	300 eV $\frac{1}{2}$ 10	3206 $\frac{1}{2}$	1 $\frac{1}{2}$
8065 $\frac{1}{2}$	3/2-, (1/2-) $\frac{1}{2}$	90 eV $\frac{1}{2}$ 10	3210 $\frac{1}{2}$	0.3 $\frac{1}{2}$
8071 $\frac{1}{2}$	3/2- $\frac{1}{2}$	80 eV $\frac{1}{2}$ 10	3216 $\frac{1}{2}$	2.6 $\frac{1}{2}$
8075 $\frac{1}{2}$	9/2+, (7/2+) $\frac{1}{2}$	>55 eV $\frac{1}{2}$	3220 $\frac{1}{2}$	53 $\frac{1}{2}$

† From 1976Wi16, unless otherwise indicated. Uncertainty in proton energies is estimated to be 0.1 keV (as specified in a previous paper by 1976Wi16), whereas the uncertainty in the excitation energy is 2 keV, essentially due to $\Delta S(\text{p})$.

‡ From 1974Ma39.

$§$ From theoretical fits to the experimental data.

⁴²Ca(p,p')γ: Resonances 1984Ka27

1984Ka27: E=3.00–3.35 MeV. Measured (inelastically) scattered protons and γ-rays, σ(θ). For proton spectrum, FWHM=6 keV.

⁴³Sc Levels

E(level) [†]	Jπ [@]	E(p)(lab) [#]	Cross section (mb) [#]	E(level) [†]	E(p)(lab) [#]	Cross section (mb) [#]
8021 [‡]		3165	11	8112 [§]	3258	0.9
8027 [§]		3171	0.3	8122 [§]	3268	1.7
8054 [§]		3198	0.4	8132 [§]	3278	2.9
8063 [‡]		3208	37	8139 [§]	3285	1.3
8068 [‡]	3/2-	3212	27	8149 [§]	3296	1.4
8074 ^{‡§}	3/2-	3220 ^{&}	51	8193 [§]	3341	0.7
8093 ^{‡§}		3237 ^a	20			

[†] From E_{c.m.}+S(p) where S(p)=4929.8 19 from 2012Wa38 and E_{c.m.} deduced from E_p(lab) unless otherwise noted.

[‡] (p,p') from 1525, 2+ (1525γ) in ⁴²Ca.

[§] (p,p') from 1837, 0+ (312γ to 1525 level) in ⁴²Ca.

[#] Values read off the plots shown by 1984Ka27.

[@] From σ(θ).

[&] σ=2.9 mb for scattering from 1837, 0+.

^a σ=1.1 mb for scattering from 1837, 0+.

⁴²Ca(d,n) 1971Bo04,1968Gr06

Target ⁴²Ca Jπ=0+.

1971Bo04: E=5.0–6.05 MeV deuteron beam was produced from the CN Van de Graaff at the Hahn–Meitner–Institute, Berlin.

Target of a 100 μg/cm² CaCO₃ enriched to 92%. Neutron energy was measured by time-of-flight, FWHM=100 keV.

Measured σ(E_n,θ). Deduced levels, J, π, L and spectroscopic factors from DWBA analysis.

1968Gr06: E=5.15 MeV deuteron beam was produced from the University of Alberta 5.5 MeV Van de Graaff accelerator.

Target of a 86.4% enriched ⁴²Ca metal evaporated onto a 125 μm gold backing. Measured σ(E_n,θ). Deduced levels, spectroscopic factors from DWBA analysis.

1992NaZN: E=25 MeV. Measured σ(θ), deduced spectroscopic factors. FWHM=150 keV. A total of 48 groups reported, out of which 22 groups are above 6.2 MeV.

1971De17: E<5.5 MeV. Measured σ(E).

1965Ok01: measured σ(θ).

⁴³Sc Levels

E(level) [†]	L [§]	(2J+1)C ² S [‡]	Comments
0.0	3	4.0	(2J+1)C ² S: other: 4.1 (1992NaZN).
152 12	2	1.1	(2J+1)C ² S: other: 0.91 (1992NaZN).
475 11	1	0.31	(2J+1)C ² S: other: 0.30 (1992NaZN).
860 10	0	0.14	(2J+1)C ² S: other: 0.64 (1992NaZN).
1177 9	1	0.72	(2J+1)C ² S: other: 0.69 (1992NaZN).
1395 13			
1817 9	1	0.40	(2J+1)C ² S: other: 0.35 (1992NaZN).
1947 13	1	0.04	L,(2J+1)C ² S: L=0, S=0.03 (1968Gr06).
2117 9	(1)	0.08	(2J+1)C ² S: other: 0.085 (1992NaZN).
2310 10	3	1.3	(2J+1)C ² S: other: 1.1 (1992NaZN).
2657 10	(0)	0.05	E(level): from 1971Bo04 and 1992NaZN. (2J+1)C ² S: other: 0.18 (1992NaZN).
2830 [#]	1+3 [#]	0.020, 0.11 [#]	(2J+1)C ² S: for p3/2 and f5/2.
2930 [#]	2 [#]	0.070, 0.054 [#]	
2977 11			
3330 [#]	3 [#]	0.34, 0.28 [#]	
3460	2	0.25, 0.20	E(level): from 1971Bo04 and 1992NaZN. L,(2J+1)C ² S: from 1992NaZN.
3630 9			
3683 9	3	0.90	(2J+1)C ² S: other: 0.84,0.61 (1992NaZN).
3940	3	0.80, 0.60	E(level): from 1971Bo04 and 1992NaZN. L,(2J+1)C ² S: from 1992NaZN.
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⁴²Ca(d,n) 1971Bo04,1968Gr06 (continued)

⁴³Sc Levels (continued)

E(level) [†]	L [§]	(2J+1)C ² S [‡]	Comments
4243 9	3	2.2	(2J+1)C ² S: 1978En02 give (2J+1)S=6.5 with C ² =2 for T=3/2. Other: 1.5 (1992NaZN).
4379 9	3	0.8	(2J+1)C ² S: other: 0.50,0.37 (1992NaZN).
4580 15			
4670 9	1	0.13	
4725 9	1	0.13	(2J+1)C ² S: 1978En02 give (2J+1)S=0.38 with C ² =2 for T=3/2. Other: 0.33,0.34 (1992NaZN).
4898 9	(1)	0.21	E(level),L,(2J+1)C ² S: 1992NaZN give L=2, S=0.33,0.27 for a 4910 group.
5026 9	1	0.47	(2J+1)C ² S: other: 0.56,0.56 (1992NaZN).
5260 #	1 #	0.13, 0.13 #	
5511 9	1	0.37, 0.38	L,(2J+1)C ² S: from 1992NaZN for a 5540 group.
5647 9	1	0.11	
5715 9	1	0.16	(2J+1)C ² S: other: 0.37,0.38 (1992NaZN).
5826 9			
5988 9			
6041 9	1	0.08	(2J+1)C ² S: other: 0.26,0.27 (1992NaZN).
6155 9	1	1.15	(2J+1)C ² S: 1978En02 give (2J+1)S=3.4 with C ² =2 for T=3/2. Other: S=1.7 (1992NaZN).
6777 #	1 #	0.53, 0.48 #	
7030 #	1 #	0.51, 0.55 #	
7160 #	2 #	0.19, 0.18 #	
7380 #	1 #	0.35, 0.37 #	
7530 #	1 #	0.32, 0.34 #	
7700 #	3 #	0.41, 0.30 #	
7900 #	3 #	0.20, 0.15 #	
8111 #	3 #	0.30, 0.23 #	
8380 #	3 #	0.77, 0.57 #	
8690 #	3 #	0.35, 0.26 #	
8910 #	3 #	0.42, 0.31 #	
9170 #	3 #	0.45, 0.33 #	
9450 #	3 #	0.55, 0.40 #	
9750 #	3 #	0.62, 0.45 #	
10040 #	3 #	0.46, 0.34 #	
10230 #	2 #	0.18, 0.17 #	
10750 #	3 #	0.44, 0.32 #	
10910 #	3 #	0.57, 0.42 #	
11260 #	3 #	0.58, 0.43 #	
11560 #	3 #	0.31, 0.23 #	
11840 #	1 #	0.25, 0.27 #	
12090 #	1 #	0.30, 0.32 #	

[†] From 1968Gr06, unless otherwise stated. Above 6155, levels reported by 1992NaZN only are not given in the adopted levels due to poor resolution in this region and weak peaks, as judged from spectrum shown by 1992NaZN.

[‡] From 1971Bo04. When unknown, J=3/2 for L=1 and J=7/2 for L=3 is assumed. Relative values for first few levels are also available from 1968Gr06. Values quoted by 1978En02 are (2J+1)S and have been adjusted upwards by ≈50% based on revised normalization factor N. When values are quoted from 1992NaZN, the first value corresponds to L-1/2 and the second value to L+1/2.

[§] From 1971Bo04, unless otherwise stated. L values from 1968Gr06 measured for g.s., 475, 860, 1177, 1817, 1947 and 6155 are in agreement with those from 1971Bo04, except for the 1947 level.

From 1992NaZN only.

⁴²Ca(³He,d) 1971Bo04,1968Br08,1966Sc17

1971Bo04 (also 1967LyZY): E=18 MeV ³He beam was produced from the EN Tandem Van de Graaff of the Max-Planck-Institut, Heidelberg. Target enriched ⁴²Ca metal foil. Deuterons were momentum analyzed with a broad-range magnetic spectrograph and detected by a ΔE-E counter telescope, overall FWHM=20 keV. Measured σ(E_d,θ). Deduced levels, J, π, L, spectroscopic factors from DWBA analysis. The uncertainty in cross sections is expected to be about 25%.

1968Br08: E=16.5 MeV. A total of 50 groups reported, but about 15 groups not confirmed by 1971Bo04.

1966Sc17: E=11 MeV ³He beam was produced from the tandem Van de Graaff accelerator at Argonne National Laboratory. Target of enriched CaCO₃ on tantalum backing. Deuterons were momentum analyzed with a broad-range magnetic spectrograph and detected in nuclear emulsions. Measured σ(E_d,θ). A total of 30 groups reported with L transfers for ten of these.

Others:

1974La14: E=15, 18 MeV.

Continued on next page (footnotes at end of table)

⁴²Ca(³He,d) 1971Bo04,1968Br08,1966Sc17 (continued)

1973GuZR (also 1972BrXX): no details are available.

1968To17: measured $\sigma(\theta)$.

1968Ly02: E=18 MeV, measured $\sigma(E_d, \theta)$.

d σ /d Ω (max) mb/sr (1971Bo04)			
E(level)	cross section	E(level)	cross section
0	4.13	4662	1.84
154	1.28	4712	1.77
470	5.35	4765	0.22
851	2.07	4810	0.76
1179	14.2	4887	2.25
1809	6.70	5007	4.86
1958	0.71	5187	0.76
2097	1.10	5258	1.07
2291	1.41	5317	0.25
2657	0.69	5490	0.62
2681	0.53	5530	0.47
2978	0.08	5633	1.58
3330	1.24	5724	3.12
3474	0.27	5819	0.52
3613	0.59	5871	0.64
3673	1.77	5921	1.52
3786	0.11	5964	0.75
3939	0.30	6024	1.35
3956	0.15	6079	1.40
3985	0.29	6145	10.3
4234	5.49	6384	0.50
4363	0.62	6444	0.81
4388	0.65	6704	5.54
4555	0.61	6811	1.20
4584	0.21	6917	0.33

⁴³Sc Levels

E(level) [†]	L [‡]	(2J+1)C ² S [§]	Comments
0.0	3	4.4	(2J+1)C ² S: 6.4 (1966Sc17).
154 10	2	0.95	(2J+1)C ² S: 1.05 (1966Sc17).
470 10	1	0.30	(2J+1)C ² S: 0.57 (1966Sc17).
846 [#] 8			
851 10	0	0.11	E(level): 856 (1966Sc17), 857 (1968Br08). (2J+1)C ² S: 0.38 (1966Sc17).
876 [#] 8			
1179 10	1	0.81	(2J+1)C ² S: 1.4 (1966Sc17).
1647 10			E(level): from 1966Sc17. Not reported by 1971Bo04.
1809 10	1	0.45	(2J+1)C ² S: 0.57 (1966Sc17).
1958 10	1	0.04	
2097 10	1	0.07	(2J+1)C ² S: 0.10 (1966Sc17).
2120? [#] 10			
2291 10	3	1.6	(2J+1)C ² S: 1.3 (1966Sc17).
2339 [#] 10			
2395 [#] 10			
2606 [#] 10			
2657 10	0	0.06	
2681 10			
2875 [#] 10			
2978 10			
3191 [#] 10			
3258 [#] 10			
3330 10	3	0.25	
3452 [#] 10			
3474 10	3	0.13	
3500 [#] 10			
3613 10			
3673 10	3	0.85	(2J+1)C ² S: 0.67 (1966Sc17).
3786 10			

Continued on next page (footnotes at end of table)

$^{42}\text{Ca}(^3\text{He},\text{d})$ 1971Bo04,1968Br08,1966Sc17 (continued)

 ^{43}Sc Levels (continued)

E(level) [†]	L [‡]	(2J+1)C ² S [§]	Comments
3939 10	3	0.11	
3956 10			
3985 10			
4234 10	3	2.2	(2J+1)C ² S: 2.1 (1966Sc17) 1978En02 quote (2J+1)S=5.5 for T=3/2.
4363 10	3	0.17	
4388 10	3	0.24	
4555 10			
4584 10			
4662 10	1	0.15	
4712 10	1	0.13	(2J+1)C ² S: 1978En02 quote (2J+1)S=0.32 for T=3/2.
4765 10	1	0.02	
4810 10	1	0.07	
4876 [#] 10			
4887 10	1	0.21	
4927 [#] 10			
5007 10	1	0.35	
5187 10			
5258 10	1	0.14	
5317 10			
5446 [#] 10			
5490 10	1	0.07	
5530 10	1	0.05	
5633 10	1	0.16	
5724 10	1	0.31	
5819 10			
5871 10			
5921 10			
5964 10			
6024 10	1	0.16	
6079 10			
6105 [#] 10			
6145 10	1	1.4	(2J+1)C ² S: 1978En02 quote (2J+1)S=3.5 for T=3/2.
6282 10			E(level): from 1966Sc17, not reported by 1971Bo04.
6384 10			
6444 10			
6704 10	(1)		
6811 10			
6917 10			

[†] From 1971Bo04, unless otherwise stated.

[‡] From 1971Bo04.

[§] From 1971Bo04. Values quoted by 1978En02 are (2J+1)S and adjusted upwards by ≈25% based on standardized normalization factors as in 1977En02.

[#] From 1968Br08 only. Above 2610, values quoted by 1968Br08 are lowered by 15 keV, based on comparison of energies in 1971Bo04 and 1966Sc17. Below 2610, the values may be 7 keV too high.

 $^{42}\text{Ca}(^{16}\text{O},^{15}\text{N})$ 1973Ko01

1973Ko01: E=48 MeV ^{16}O beam was produced from the Argonne FN tandem accelerator with intensity of 200–500 nA. Target of isotopically enriched 100 $\mu\text{g}/\text{cm}^2$ thick ^{42}Ca foil on 20 $\mu\text{g}/\text{cm}^2$ carbon backings. The ejectiles were identified and detected by up to six ΔE –E counter telescopes of ≈15- μm and ≈100- μm silicon surface barrier detectors, FWHM=250 keV. Measured $\sigma(\theta)$. Deduced levels, J, π , L from DWBA analysis. Absolute cross sections are accurate to 15%.

1975EiZT: E=56 MeV. Measured $\sigma(\theta)$.

 ^{43}Sc Levels

Continued on next page (footnotes at end of table)

$^{42}\text{Ca}(^{16}\text{O},^{15}\text{N})$ 1973Ko01 (continued)

 ^{43}Sc Levels (continued)

E(level)	$J\pi^\dagger$	L	$d\sigma/d\Omega$ (max) (mb/sr)
0.0	7/2-	4	0.98
470	3/2-	2	0.08
1180	3/2-	2	0.12
1810	3/2-	2	0.10

† From Adopted Levels.

 $^{43}\text{Ca}(p,n), (p,n\gamma)$ 1967Mc07

1967Mc07: (p,n): E=4.0–5.5 MeV proton beam was produced from the SUNI 5.5 MV Van de Graaff accelerator. Target of CaO evaporated onto 0.025 cm tantalum discs 2.5 cm in diam. Neutrons were detected by a NE 213 liquid scintillator. Measured $\sigma(E_n)$. Deduced levels.

1960Mc12: (p,n): E<4.9 MeV. Measured $\sigma(E)$. Deduced levels.

1971De17: (p,n): E<5.6 MeV. Measured $\sigma(E)$.

1972Bi13: (p,n γ): measured ce, deduced α (expt) for 152 γ .

 ^{43}Sc Levels

E(level) †
0.0
152 ‡ 5
476 § 5
855 $^\#$ 5
881 5
1175 10
1347 10
1424 10
1677 15

† From 1967Mc07.

‡ 138 8 (1960Mc12).

§ 456 10 (1960Mc12).

$^\#$ 874 10 (1960Mc12).

 $\gamma(^{43}\text{Sc})$

E_γ	E(level)	Mult.	Comments
152	152	M2	Mult.: from α (expt)=0.041 4 (1972Bi13).

 $^{43}\text{Ca}(^3\text{He},t)$ 1971Al19

$J\pi(^{43}\text{Ca g.s.})=7/2-$.

1971Al19 (also 1971ScYM): E=26 MeV ^3He beam was produced from the MP tandem Van de Graaff at the University of Rochester Nuclear Structure Laboratory. Target of 81.12% enriched 50 $\mu\text{g}/\text{cm}^2$ CaCO_3 on a 20 $\mu\text{g}/\text{cm}^2$ carbon backing. Tritons were momentum analyzed with an ENge split-pole spectrograph (FWHM=15–20 keV) and detected in 50 μg NTB emulsion in the focal plane. Measured $\sigma(E_t, \theta)$. Deduced levels. Uncertainty in cross sections is $\approx 25\%$.

1971Be29: E=24.6 MeV. Measured $\sigma(\theta)$. Deduced Coulomb-displacement energy=7238 4.

All data are from 1971Al19 unless otherwise noted.

 ^{43}Sc Levels

Continued on next page (footnotes at end of table)

$^{43}\text{Ca}(^3\text{He},t)$ 1971Al19 (continued) **^{43}Sc Levels (continued)**

E(level)	L	$d\sigma/d\Omega$ (30°) ($\mu\text{b/sr}$)	E(level)	L	$d\sigma/d\Omega$ (30°) ($\mu\text{b/sr}$)	E(level)	L	$d\sigma/d\Omega$ (30°) ($\mu\text{b/sr}$)
0.0 [#]		28.9	2333 [†]		0.7	3894 8		13.9
152 [†]		1.7	2455 [‡] 4		16.7	3931 8		7.1
473 [†]		0.8	2620 [†] ?		<0.5	4128? [@] 8		3.2
846 [†]		<1.1 [§]	2630 4		6.3	4230& 8	0	46.8
856 [†]		<1.1 [§]	2670 [†]		1.2	4276 8		3.5
880 [†]		<1.1 [§]	2756 [#] 4		4.7	4343 8		3.0
1178 4		3.9	2983 4		16.3	4371 [‡] 8		18.9
1402 4		1.5	3120 4		15.4	4511 8		8.8
1810 [†]		0.8	3254 4		9.9	4658 [‡] 8		
1826 4		9.2	3324 4		9.6	4766 8		8.8
1881 4		6.5	3464 [‡] 8		7.7	4821 ^a 8	2	4.4
2244 [†]		0.6	3667 8			4871 8		21.2
2284 [#] 4		11.6	3843 8		7.4			

[†] Rounded off energy from Adopted Levels. Poor statistics in ($^3\text{He},t$) (1971Al19).

[‡] Doublet.

[§] 1.1 for 846+856+880.

[#] $\sigma(\theta)$ is similar to 1+ to 0+ spin-flip transitions.

[@] Possible contaminant.

& Average of 4234 8 (1971Be29) and 4226 8 (1971Al19). Strongest transition. Interpreted as $\Delta(T)=0$ transition to the IAS of ^{43}Ca g.s. Coulomb-displacement energy=7238 4 (1971Be29).

^a Probable IAS of 593, 3/2- in ^{43}Ca .

 $^{45}\text{Sc}(p,t)$ 1977SaZF,1973Se01

$J\pi(^{45}\text{Sc g.s.})=7/2^-$.

1977SaZF: E=40 MeV. Measured $\sigma(\theta)$, DWBA analysis.

1973Se01: E=52 MeV proton beam was produced from the synchrocyclotron at the Institute for Nuclear Studies. Target of scandium oxide on Mylar backings. Tritons were momentum analyzed with a broad-range spectrograph and detected with a proportional counter, FWHM=70 keV. Measured $\sigma(E_{\text{tr}},\theta)$. Deduced levels, L from DWBA analysis.

1972KrZD: E=27 MeV. Measured $\sigma(\theta)$.

 ^{43}Sc Levels

E(level) [†]	L [‡]	E(level) [†]	L [‡]	E(level) [†]	L [‡]
0.0	0 ^b	2633 10	2	3509 10	0
470 [§] 10	2	2670 10	2	3676 10	3
850 [§] 10	2	2760 ^a 10	4 ^a	3700 10	6
1180 [§] 10	2	2793 10	2	3771 10	5
1410 [§] 10	0 ^b	2838 10	5	3807 10	5
1811 [#]	2	2859 10	3	3848 10	5
1830 [§] 10	2 ^b	2984 10	4	3949 10	3
1880 [§] 10	2 ^b	3123 10	6	4015 10	5
1933 [#]	5	3205 10	(4)	4049 10	4
2110 [@] 10	(3+5)	3257 10	4	4138 10	5
2246 10	2	3290 10	2	4169 10	4
2291 10	4	3328 10	2	4211 10	3
2337 10	2 ^b	3373 10	2	4239 10	0 ^b
2460 10	2 ^b	3448 10	5	4650 [§] 10	
2549 10	(5,6)	3480 10	3	5236& 10	

[†] From 1977SaZF (as quoted by 1978En02), unless otherwise stated. There are four additional levels between 5700 and 6100 in 1977SaZF.

[‡] From 1977SaZF (as quoted by 1978En02), unless otherwise stated.

[§] From 1973Se01.

[#] Rounded off energy from Adopted Levels.

[@] Doublet.

& 5250 (1973Se01).

^a L=3 for a 2780 group (1973Se01).

^b From 1973Se01.

⁴⁶Ti(p,α),(pol p,α) 1982Ab03,1981Bo37,1965P101

1982Ab03: (p,α) E=40.35 MeV proton beam was produced from the University of Manitoba sector-focused cyclotron.

Target of 81.2% enriched Ti metal. α particles were detected by 6 counter telescopes of ΔE-E silicon surface barrier detectors, FWHM=70–80 keV. Measured σ(E_α,θ). Deduced levels, J, π from DWBA analysis.

1981Bo37: (pol p,α) E=79.2 MeV polarized proton beam was produced from the Indiana University Cyclotron Facility

(IUCF). Target of self-supporting enriched Ti foils. α particles were momentum analyzed with the IUCF QDDM magnetic spectrograph and detected in the 1 m long focal plane detector, FWHM=80–100 keV. Measured σ(α,θ) and A_y(θ). Deduced levels, J, π from DWBA calculations.

1965P101: (p,α) E=10 MeV proton beam was produced from the Florida State University Tandem Van de Graaff accelerator. Target of TiO₂ on a carbon backing. α particles were momentum analyzed with a broad range magnetic spectrograph and detected on 50 μm thick Kodak-NTA emulsions. Measured σ(E_α,θ). Deduced levels.

1971NoZX: (p,α) E=30 MeV. Measured σ(θ).

⁴³Sc Levels

σ(theory)=N×σ(DWBA), where N=47.2×10⁶ to give 1.0 for g.s.

E(level) [†]	Jπ	Relative cluster factors ^a	Comments
0.0	7/2-@&	1.2	σ(exp)/σ(theory)=1.0.
151.3	3/2+&		σ(exp)/σ(theory)=0.75.
479.5			
840.‡	5/2-@		
856.8	1/2+&		σ(exp)/σ(theory)=2.5.
884.8			
1188.8			
1400	7/2-&		σ(exp)/σ(theory)=0.1.
1640.‡	5/2+@		
1830	11/2-@&	0.27	σ(exp)/σ(theory)=1.8.
2130#			
2250#			
2650#			
2870	(5/2+, 9/2+)§		Jπ: σ(θ) (1982Ab03) fits 7/2+.
			σ(exp)/σ(theory)=5.5.
2990	15/2-@	0.67	σ(exp)/σ(theory)=1.2.
3120	19/2-@	1.0	σ(exp)/σ(theory)=0.5.
3470#			
3810#			
4180.‡	(9/2+, 13/2+)§		
4230	7/2-&		σ(exp)/σ(theory)=1.1.
4360.‡	17/2-	≤0.11	Jπ: poor fit of σ(θ) and A _y (θ) data in (pol p,α) to 17/2- due probably to contribution from other levels in the vicinity or to complex reaction mechanism.
4550?‡	(11/2+, 13/2-)§	0.34	
4700.‡	(15/2+)§		
5200.‡	17/2+§		
5230	3/2+&		
6220	1/2+&		

[†] From 1965P101 for levels below 1200. Above this energy, values are from 1982Ab03, unless otherwise indicated.

[‡] From 1981Bo37.

§ From A_y(θ) in (pol p,α).

From spectrum figure of 1982Ab03.

@ σ(θ) and A_y(θ) data in (pol p,α) are consistent with the assigned Jπ.

& From comparison of σ(θ) with DWBA calculations (1982Ab03).

^a From 1981Bo37, normalized to 1.0 for 19/2-, 3120 state.

Adopted Levels, Gammas

Q(β⁻)=-11400 40; S(n)=12288 7; S(p)=4489 7; Q(α)=-4463 7 2012Wa38.
S(2n)=29766 29, S(2p)=8761 7, Q(εp)=1937 7 (2012Wa38).
1988Kr11: ⁴⁰Ca(¹²C,⁹Be), E=480 MeV ¹²C beam at GANIL populated only the 19/2- 3066 keV level.
1987Th02: ⁴²Ca(pol p,π⁻), measured cross section and analyzing power.
1983Wa05: ⁴⁰Ca(³He,γ), E=3.19 MeV, measured σ(E,θ), deduced a broad resonance at level of 18.7 MeV 2 with Γ=3.1 MeV 3.
1982Vi05: ⁴²Ca(p,π⁻), measured cross section.
1974An36, 1972Sc21: ⁴⁰Ca(¹²C,⁹Be), E=114 MeV, measured σ.
Mass measurement: 2000HaZY, 1977Mu03, 1972Pr10.
Production cross section measurements: 1994Bl10.
Structure calculations: 2010Qi01, 2008Bo23, 2008Pe13, 2006Za08, 2003Ra45, 2001Ro13, 2000De10, 1999Ca12, 1997Bo47, 1992Po04.

⁴³Ti Levels

Cross Reference (XREF) Flags

A ⁴⁴Cr εp Decay (42.8 ms)
B Be(⁵⁸Ni,Xγ)
C ⁴⁰Ca(α,nγ)
D ⁴⁰Ca(⁶Li,t)
E ⁴⁶Ti(³He,⁶He)

E(level) [†]	Jπ	XREF	T _{1/2}	Comments
0.0	7/2-	ABCDE	509 ms 5	<p>%ε+%β⁺=100; %εp=? μ=0.85 2 (1993Ma67,2014StZZ). μ: β-NMR in Pt (1993Ma67,1993Ma72,1992Ma63). Jπ: log ft=3.56 to 7/2- g.s. of ⁴³Sc (super-allowed transition). Mirror state of 7/2-, g.s. in ⁴³Sc. T_{1/2}: from β activity in 1987Ho14. Others: 0.58 s 4 (1948Sc20), 0.58 s (1954Ty33), 0.56 s 2 (1961Ja22), 0.528 s 3 (1960Ja12), 0.50 s 2 (1962Pl02), 0.40 s 5 (1963Va37), 0.49 s 1 (1967Al08)</p>
313.0 10	(3/2+)	BC E	11.9 μs 3	<p>Jπ: (3/2+) proposed in (³He,⁶He) from similarity of σ(θ) pattern of 3/2+ states, all believed to be from d_{3/2} orbit, in ³⁹Ca, ⁴⁷Cr, ⁵¹Fe and ⁵⁵Ni. Possible mirror state of 150, 3/2+ level in ⁴³Sc. T_{1/2}: weighted average of 11.7 μs 3 (2011Ho02) and 12.6 μs 6 (1978Me15), both from γ(t).</p>
475 10	(3/2-)	DE		<p>XREF: D(520). Jπ: possible mirror state of 3/2-, 472 level in ⁴³Sc.</p>
998 10	(1/2+)	C E		<p>E(level): population of this level in (α,nγ) is uncertain. From energy matching, the strong group in (³He,⁶He) may correspond to 1022.4 from (α,nγ) (as proposed in 1990En08) but proposed Jπ assignments (1/2+ for 998 in (³He,⁶He) and 5/2+ for 1022 in (α,nγ)) disfavor this correspondence. Jπ: (1/2+) proposed in (³He,⁶He) from similarity of σ(θ) pattern of 1/2+ states, all believed to be from d_{3/2} orbit, in ³⁹Ca, ⁴⁷Cr, ⁵¹Fe and ⁵⁵Ni.</p>
1022.4 10	(5/2+)	A		Jπ: possible mirror state of 5/2+, 880 level in ⁴³ Sc.
1160 10	(1/2 to 5/2)-	DE		Jπ: L(⁶ Li,t)=1 suggests 1/2-,3/2-,5/2-.
1483.5 10	(7/2+)	C E		Jπ: possible mirror state of 7/2+, 1337 level in ⁴³ Sc.
1760 30	(1/2 to 5/2)-	De		Jπ: L(⁶ Li,t)=1 suggests 1/2-,3/2-,5/2-.
1857.7 10	(11/2-)	BCDe		Jπ: L(⁶ Li,t)=(5) suggests 7/2- to 13/2-. 11/2- is supported by yrast sequence (19/2-) - (15/2-) - (11/2-) - 7/2 and probable mirror state of 11/2-, 1830 level in ⁴³ Sc.
2062.4 10	(9/2+)	C		Jπ: possible mirror state of 9/2+, 1931 level in ⁴³ Sc.
2250 10		DE		Jπ: L(⁶ Li,t)=3 suggests 3/2- to 9/2-.
2438 9		E		
2640 30		D		Jπ: L(⁶ Li,t)=5 suggests 7/2- to 13/2-.
2951.7 10	(15/2-)	BCDE		<p>XREF: E(2990). Jπ: L(⁶Li,t)=7 suggests 11/2- to 17/2-. 15/2- is supported by γ from (19/2-) in an yrast sequence and probable mirror state of 15/2-, 2987 level in ⁴³Sc.</p>

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

⁴³Ti Levels (continued)

E(level) [†]	J π	XREF	T _{1/2}	Comments
3066.4 10	(19/2-)	BC	556 ns 6	μ =+7.22 1 (1978Ha07,2014StZZ). Q=0.33 8 (1981Da06,2014StZZ,2013StZZ). μ : TDPAD (1978Ha07). Q: TDPAD (1981Da06; original value of 0.30 7 re-evaluated to 0.33 8 by 2013StZZ. J π : from agreement of experimental μ with that calculated from shell-model with configuration= $v(f_{7/2}^3+f_{7/2}^2f_{5/2})$. Probable mirror state of (19/2-), 3123 level in ⁴³ Sc with T _{1/2} =472 ns 4. T _{1/2} : weighted average of 551 ns 7 (2011Ho02), 560 ns 6 (1978Ha07), 553 ns 21 (1981Da06), 560 ns 35 (1978Me09); from $\gamma(t)$. J π : L(⁶ Li,t)=(9) suggests 15/2- to 21/2-.
3220 30		D		J π : L(⁶ Li,t)=(9) suggests 15/2- to 21/2-.

[†] From (α ,n γ). From (³He,⁶He) when a level is not populated in γ -ray study.

$\gamma(^{43}\text{Ti})$

E(level)	E γ [†]	I γ	Mult.	Comments
313.0	312.7 2	100	[M2]	E γ : from Be(⁵⁸ Ni,X γ). B(M2)(W.u.)=0.0710 18.
1022.4	709.4			
1483.5	1170.5			
1857.7	1857.7		[E2]	
2062.4	1040.0			
2951.7	1094.0		[E2]	
3066.4	114.7	100	[E2]	B(E2)(W.u.)=5.7 3.

[†] From (α ,n γ) unless otherwise noted.

⁴⁴Cr $\epsilon\pi$ Decay (42.8 ms) 2007Do17,2014Po05

Parent ⁴⁴Cr: E=0; J π =0+; T_{1/2}=42.8 ms 6; Q(g.s.)=8400 syst; $\epsilon\pi$ decay=12 2.

⁴⁴Cr-T_{1/2}: From ⁴⁴Cr Adopted Levels in ENSDF database, taken from 2007Do17. Others: 25 ms +6-4 from 2014Po05 (time correlation of implantation events due to ⁴⁴Cr and subsequent emission of protons, and using the maximum likelihood method); 53 ms +4-3 (1992Bo37). All the three values are in disagreement. Unweighted average of three values is 40.3 ms 82, much nearer to the 2007Do17 value.

⁴⁴Cr-Q($\epsilon\pi$): 8400 300 (syst,2012Wa38).

⁴⁴Cr- $\epsilon\pi$ decay: $\epsilon\pi$ =10 1 (2014Po05), 14.0 9 (2007Do17). 2014Po05 discuss accuracy of results in the two measurements.

2007Do17: Fragmentation reaction used to produce ⁴⁴Cr isotope at SISSE/LISE3 facility in GANIL. Primary beam:

⁵⁸Ni²⁶⁺ at 74.5 MeV/nucleon; target=natural Ni. Fragment separator=ALPHA-LISE3. Fragment identification by energy loss, residual energy and time-of-flight measurements using two micro-channel plate (MCP) detectors and Si detectors. Double-sided silicon-strip detectors (DSSSD) and a thick Si(Li) detector were used to detect implanted events, charged particles and β particles. The γ -rays were detected by four Ge detectors. Coincidences measured between charged particles and γ -rays. T_{1/2} measured by time correlation of implantation events due to ⁴⁴Cr and subsequent emission of protons and γ -rays. Total proton branching ratio is from time spectrum of events with energy >900 keV in the charged-particle spectrum. Possible small contributions from delayed- α and delayed-2p decays are ignored.

2014Po05: ⁴⁴Cr isotope produced in fragmentation of Ni target with a ⁵⁸Ni beam at 160 MeV/nucleon from the NSCL, MSU facility. Fragments separated with the A1900 fragment separator and identified using time-of-flight and energy-loss techniques. The optical time projection chamber (OTPC) was used to detect fragments and the decay of heavy particles such as protons or α particles. Measured half-life of ⁴⁴Cr g.s. from time correlation of implantation events and subsequent emission of protons. Total proton branching ratio was measured based on incoming ions and decay events.

⁴³Ti Levels

Continued on next page (footnotes at end of table)

^{44}Cr ϵp Decay (42.8 ms) 2007Do17,2014Po05 (continued) ^{43}Ti Levels (continued)E(level)

0.0

Delayed protons

<u>E(p)[‡]</u>	<u>E(^{43}Ti)</u>	<u>I(p)[†]</u>	<u>Comments</u>
742.26		0.6 2	E(p): reported by 2014Po05 only; uncertainty of 24 keV from minimization procedure and 10 keV from drift velocity added in quadrature.
1384.12		1.1 3	E(p)=1340.62, I(p)=1.4% 3 (2014Po05).
1741.15		0.6 3	E(p)=1680.44, I(p)=0.5% 2 (2014Po05).
908.11	0.0	1.7 3	E(p)=896.53, I(p)=2.7% 5 (2014Po05).

[†] Absolute intensity per 100 decays.[‡] The proton energies are in the center-of-mass system. **$^{40}\text{Ca}(\alpha, n\gamma)$ 1978Me15**

1978Me15, 1978Me09: E=20 MeV α beam was produced at the Argonne National Laboratory. Target of an enriched (>99.9%) ^{40}Ca with thickness of about 1 mg/cm², evaporated onto a 0.127 mm thick Pb foil. Neutrons and γ -rays were separated by pulse-shape discrimination using a 5-cm diam by 2.5-cm thick stilbene crystal. γ -rays were detected with a 70-cm³ Ge(Li) detector. Measured E γ , I γ , $\gamma(t)$, n $\gamma(t)$, $\gamma\gamma(t)$. Deduced levels, T_{1/2}.

1978Ha07: E=21 MeV α beam was produced from the Chalk River MP tandem accelerator. Targets of $\approx$ 10 mg/cm² ^{40}Ca . Delayed γ -rays were detected with Ge(Li) detectors. Measured $\gamma(\theta, H, t)$. Deduced g factors, T_{1/2}.

1981Da06: E=21 MeV α beam was produced from the Stony Brook FN tandem. Target of a 400 $\mu\text{g}/\text{cm}^2$ Ca. γ -rays were detected with both NaI and Ge(Li) detectors. Measured $\gamma\gamma(\theta, H, t)$. Deduced levels, T_{1/2}, quadrupole moments.

Others: 1976Fi08.

All data are from 1978Me15 and 1978Me09 unless otherwise noted.

 ^{43}Ti Levels

<u>E(level)</u>	<u>Jπ[†]</u>	<u>T_{1/2}</u>	<u>Comments</u>
0.0	7/2-		J π : from Adopted Levels.
313.0 10	(3/2+)	12.6 μs 6	T _{1/2} : from $\gamma(t)$ in 1978Me15.
999?	(1/2+)		
1022.4 10	(5/2+)		
1483.5 10	(7/2+)		
1857.7 10	(11/2-)		
2062.4 10	(9/2+)		
2951.7 10	(15/2-)		
3066.4 10	(19/2-)	560 ns 6	μ =+7.22 1 (1978Ha07); Q=0.30 7 (1981Da06). μ, Q : DPAD method. T _{1/2} : from $\gamma(t)$ (1978Ha07). 553 ns 21 from 1981Da06.

[†] From analogy with mirror nucleus ^{43}Sc . $\gamma(^{43}\text{Ti})$

<u>Eγ</u>	<u>E(level)</u>	<u>Mult.</u>
114.7	3066.4	[E2]
313.0	313.0	
686 [†]	999?	
709.4	1022.4	
1040.0	2062.4	
1094.0	2951.7	
1170.5	1483.5	
1857.7	1857.7	

Footnotes continued on next page

⁴⁰Ca($\alpha, n\gamma$) 1978Me15 (continued)

$\gamma(^{43}\text{Ti})$ (continued)

[†] Placement of transition in the level scheme is uncertain.

⁴⁰Ca(⁶Li, t) 1974Li01

1974Li01: E=34.0 and 36.0 MeV ⁶Li beams were produced from the University of Rochester MP Tandem accelerator, with intensity of 300–400 nA. Targets of $\approx 75 \mu\text{g}/\text{cm}^2$ natural ⁴⁰Ca on carbon and gold backings. Tritons were detected in a spark counter mounted in the focal plane of a magnetic spectrograph, FWHM=50 keV. Measured $\sigma(\theta)$. Deduced levels, L, J, π from DWBA analysis.

1986Pl01: E=156 MeV Measured (fragment) γ -coin, $\sigma(\theta)$.

1982Ne02: E=156 MeV, measured $\sigma(\theta)$.

All data are from 1974Li01 unless otherwise noted.

⁴³Ti Levels

E(level)	L [†]	S
0.0	3	1.0
520 30		
1150 30	1	2.5
1760 30	1	1.5
1860 30	(5)	0.63
2230 30	3	1.8
2640 30	5	0.35
2950 30	7	0.24
3220 30	(9)	0.55

[†] From $\sigma(\theta)$. $J\pi$ values implied are: 1/2– to 5/2– for L=1; 3/2– to 9/2– for L=3; 7/2– to 13/2– for L=5; 11/2– to 17/2– for L=7 and 15/2– to 21/2– for L=9.

⁴⁶Ti(³He, ⁶He) 1977Mu03

1977Mu03 (also 1977MuZS): E=70 MeV ³He beam was produced by the MSU cyclotron and incident on thin isotopically enriched carbon-backed metal foils. ⁶He particles were detected by a resistive-wire gas-proportional counter.

Measured $\sigma(\theta)$. Deduced levels, mass excess, Q.

1972Pr10: E=65–75 MeV beams were produced from the MSU sector-focused cyclotron. ⁶He particles were analyzed and detected in the focal plane of an Enge split-pole magnetic spectrograph. Measured $\sigma(E(^6\text{He}))$. Deduced mass.

Others: 1975Mu09.

⁴³Ti Levels

E(level) [†]	$J\pi^{\ddagger}$
0.0	(7/2–)
319 6	(3/2+)
475 10	
998 10	(1/2+)
1160 10	
1470 10	
1800 15	
2250 10	
2438 9	
2990 15	

[†] From 1977Mu03.

[‡] From similarity of $\sigma(\theta)$ pattern with states of similar configuration in ³⁹Ca, ⁴⁷Cr, ⁵¹Fe and ⁵⁵Ni (1977Mu03).

Be($^{58}\text{Ni},\text{X}\gamma$): Isomers 2011Ho02

2011Ho02: E(^{58}Ni)=550 MeV/nucleon beam was produced from the UNILAC-SIS accelerator complex at the GSI Helmholtzzentrum für Schwerionenforschung mbH, Darmstadt, Germany. Target of 4 g/cm² Be. Reaction products were separated by a 70 m long fragment separator (FRS) and identified by time-of-flight and energy loss in the MUSIC detectors. γ -rays were detected by 15 high-resolution and high-efficiency CLUSTER germanium detectors. Measured E γ , I γ . Deduced levels, T_{1/2}.

 ^{43}Ti Levels

E(level)	J $\pi^{\dagger}$	T _{1/2}	Comments
0.0	7/2-		
312.7 2	(3/2+)	11.7 μ s 3	T _{1/2} : measured by 2011Ho02, γ (t). Adopted value of 11.9 μ s 3 is given in 2011Ho02 based on averaging current value with literature value taken from ENSDF database.
1858	(11/2-)		
2952	(15/2-)		
3067	(19/2-)	551 ns 7	T _{1/2} : measured by 2011Ho02, γ (t). Adopted value of 556 ns 5 is given in 2011Ho02 based on averaging current value with literature value taken from ENSDF database.

† From Adopted Levels.

 $\gamma(^{43}\text{Ti})$

E γ	E(level)	Mult.	$\alpha^{\dagger}$	Comments
114.7 2	3067	[E2]	0.200	B(E2)(W.u.)=4.82 8.
312.7 2	312.7	[M2]	0.0048	B(M2)(W.u.)=0.072 2.
1094	2952	[E2]		
1858	1858	[E2]		

† Calculated values from 2008Ki07.

Adopted Levels

$Q(\beta^-) = -15620$ SY; $S(n) = 18370$ SY; $S(p) = 100$ 40; $Q(\alpha) = -6170$ 50 2012Wa38.

Estimated uncertainties: $\Delta Q(\beta^-) = 400$, $\Delta S(n) = 300$ (2012Wa38). $S(p) = 84$ 43 (2013Ya03, mass measurement using the cooler storage ring CSRe at Lanzhou).

$S(2n) = 34260$ 300 (syst), $S(2p) = 3850$ 40, $Q(\epsilon p) = 6920$ 40 (2012Wa38).

First identification of ^{43}V nuclide by 1987Po04.

^{43}V produced by $\text{Ni}(^{58}\text{Ni}, X)$ $E = 55$ MeV/nucleon (1987Po04) and $E = 69$ MeV/nucleon (1992Bo37), followed by measurement of fragment spectra.

Mass measurement: 2013Ya03 by storage ring and 2000HaZY by Schottky-mass spectrometry.

Structure and reaction calculations: 2009Pa18, 1999Ca12, 1997Co19, 1995He18, 1993Ma72, 1987Sa19, 1976Ha07, 1975Be56.

 ^{43}V Levels**Cross Reference (XREF) Flags**

A ^{43}Cr ϵ Decay (21.2 ms)

B $\text{Ni}(^{58}\text{Ni}, X)$

E(level)	$J\pi$	XREF	$T_{1/2}$	Comments
0.0		AB	79.3 ms 24	$\% \epsilon + \% \beta^+ = 100$; $\% \epsilon p = ?$ $T_{1/2}$: from 2007Do17. $J\pi$: 7/2- proposed from syst (2012Au07). Shell-model calculations by 2010Pe15 predict magnetic dipole moment $\mu = +5.106$ 49.
8250? 230	(3/2+)	A		E(level), $J\pi$: probable IAS of ^{43}Cr g.s. (2001Gi01).

 ^{43}Cr ϵ Decay (21.2 ms) 2001Gi01

Parent ^{43}Cr : $E = 0.0$; $J\pi = (3/2+)$; $T_{1/2} = 21.2$ ms 7; $Q(\text{g.s.}) = 15620$ syst; $\% \epsilon + \% \beta^+$ decay = 100.

$^{43}\text{Cr}-J, T_{1/2}$: From Adopted Levels of ^{43}Cr .

$^{43}\text{Cr}-Q(\epsilon)$: 15620 400 (syst, 2012Wa38).

^{43}Cr decays also by $\beta^+ p$ to ^{42}Ti and by $\beta^+ 2p$ to ^{41}Sc ; by $\beta^+ 3p$ to ^{40}Ca (2011Po01, 2012Au08).

2001Gi01: $E = 74.5$ MeV/nucleon ^{43}Cr beam was produced in projectile fragmentation experiment using $\text{Ni}(^{58}\text{Ni}, X)$ at the GANIL facility. Target of a 230.6 mg/cm² thick natural nickel and 2.7 mg/cm² thick carbon stripper. Isotopes were selected with the Alpha spectrometer and the LISE3 separator. The selected isotopes were implanted in a silicon telescope of two silicon detectors. Measured $T_{1/2}(^{43}\text{Cr})$ and delayed-proton spectra.

 ^{43}V Levels

E(level)	$J\pi$	Comments
8250 230	(3/2+)	Main β^+ decay may be to IAS state of ^{43}Cr g.s. at 8255 230 (2001Gi01).

 β^+, ϵ Data

$E\epsilon$	E(level)
(7370)	8250

 $\text{Ni}(^{58}\text{Ni}, X)$ 2007Do17

2007Do17: $E = 74.5$ MeV/nucleon $^{58}\text{Ni}^{26+}$ beam was produced at SISSE/LISE3 facility in GANIL. Target of natural Ni.

Fragments were selected by the separator ALPHA-LISE3 and identified by energy loss, residual energy and time-of-flight measurements using two micro-channel plate (MCP) detectors and Si detectors. Double-sided silicon-strip detectors (DSSSD) and a thick Si(Li) detector were used to detect implanted events, charged particles and β particles. The γ -rays were detected by four Ge detectors. Coincidences measured between charged particles and γ -rays.

Total proton branching ratio is from time spectrum of events with energy >900 keV in the charged-particle spectrum.

Possible small contributions from delayed- α and delayed- $2p$ decays are ignored (2007Do17).

Ni(${}^{58}\text{Ni},\text{X}$) 2007Do17 (continued)

 ${}^{43}\text{V}$ Levels

E(level)	$T_{1/2}^{\dagger}$	Comments
0.0	79.3 ms 24	$T_{1/2}$: earlier measured value was >800 ms by 1992Bo37. No delayed protons were detected. Thus ${}^{43}\text{V}$ decays almost 100% by $\beta^{+}+\epsilon$ decay to ${}^{43}\text{Ti}$ (2007Do17).

$\dagger$ From time correlation of implantation events due to ${}^{43}\text{V}$ and subsequent emission of protons and γ -rays (2007Do17).

Adopted Levels

S(n)=16610 SY; S(p)=1970 SY; Q(α)=-6920 SY 2012Wa38.
 Estimated uncertainties (2012Wa38): ΔS(n)=570, ΔS(p)=500, ΔQ(α)=450.
 S(2n)=37330 (calculated,1997Mo25). S(2p)=1180 413, Q(εp)=15520 400 (syst,2012Wa38).
 First identification of ⁴³Cr nuclide by 1992Bo37.
 1992Bo37: ⁴³Cr produced by Ni(⁵⁸Ni,X) E=69 MeV/nucleon, followed by measurement of fragment spectra. Measured β⁺p, E(p), I(p), T_{1/2}.
 1994Bl10: ⁴³Cr produced by ⁹Be(⁵⁸Ni,X) E=600 MeV/nucleon. Measured production cross sections.
 2001Gi01, 2001Gi02: ⁴³Cr produced by Ni(⁵⁸Ni,X) E=74.5 MeV/nucleon. Selected isotopes implanted in a ΔE-E silicon detector telescope. Measured T_{1/2}, E(p), I(p).
 2007Do17: E=74.5 MeV/nucleon ⁵⁸Ni was produced at the SISSI-LISE3 facility of GANIL, incident on a natural nickel target of 250 mg/cm². Fragments were selected by the ALPHA-LISE3 separator, identified by two micro-channel plate (MCP) detectors and detected in a detection setup consisting of silicon and germanium detectors. Measured β-delayed proton and γ spectra, branching ratios, half-life.
 2011Po01: E=161 MeV/nucleon ⁵⁸Ni beam was produced at the NSCL, MSU, incident on a target of 800 mg/cm² natural nickel foil. Reaction products were separated by the A1900 fragment separator and identified by time-of-flight (TOF) and energy-loss. Decays were detected using the Optical Time Projection Chamber (OTPC). Measured Ep, Ip, branching ratios for difference decay modes. Deduced half-life.
 2012Au08 (also 2012As02): ⁴³Cr nuclei produced in the reaction Ni(⁵⁸Ni,X), E(⁵⁸Ni)=75 MeV/nucleon using LISE3 separator at GANIL ⁴³Cr ions were separated, identified and then implanted onto the time projection chamber (TPC). Decays were detected in a time-projection chamber (TPC), where signals from four gas electron multipliers (GEM) detected in a two-dimensional strip detector combined with drift-time analysis were used to reconstruct the tracks of the particles in three dimensions. Characterization of the TCP was done with the β⁺p decay of ⁵²Ni with reference to proton energies and branching ratios. Measured energy loss, decay events, angular correlation between two protons. Deduced delayed one-, two-, and three-proton decay branching ratio. Implantation and decay events were time correlated. Recorded events in this study: 180 events for β⁺2p emission, and three events for β⁺3p emission from decay of ⁴³Cr.
 Structure and reaction calculations: 2004Bb14, 2003Br07, 2003Gr04, 2003Gr24, 1997Co19, 1994Bl10, 1991De26, 1975Be56.

⁴³Cr Levels

E(level)	Jπ	T _{1/2}	Comments
0.0	(3/2+)	21.2 ms 7	<p>%εp=79.3 30 (2012Au08); %ε2p=11.6 10 (2012Au08). %EC3P=0.13 +18-8 (2012Au08). Other: %ε+%β⁺=12 4, %εp=81 4, %ε2P=7.1 4, %ε3p=0.08 3 (2011Po01). %β⁺α=? %β⁺p=23 6 and %β⁺2p=6 5 from 1992Bo37. %β⁺p+%β⁺ 2p=12 4 to the IAS (1992Bo37). Search for β delayed α decay proved inconclusive (1992Bo37). Theory: 1991De26. Total delayed-proton emission of 88% 4 from 2011Po01 compares well with another recent measurement of 92.5% 28 by 2007Do17. Relative branching ratios of delayed protons: 91.8% 3 for one-proton, 8.1% 3 for two-proton and 0.096% 30 for three-proton emissions (2011Po01). Relative branching ratios of delayed protons: 87.1% 25 for one-proton, 12.7% 10 for two-proton and 0.14% +19-9 for three-proton emissions (2012Au08). Absolute branches were deduced using total delayed proton emission branch of 91.0% 23 from 2007Do17 and 2011Po01. Measured E(p)=4363 keV 9 (2007Do17) assigned to β⁺2p mode. From simulations studies and in comparison with the experimental results, 2012Au08 show that the two protons do not share equally the delayed-2p decay energy and are emitted sequentially. A ratio of 34%-66% between the two protons is in good agreement with experimental data. In addition, an isotropic distribution of the relative angle angle between the two protons is a signature of sequential emission which is supported by measured angular correlation between two protons emitted by the decay of ⁴³Cr (2012Au08). Jπ: proposed by 2001Gi01 from the β⁺ decay to the (3/2+) IAS state in ⁴³V. T_{1/2}: weighted average of 20.6 ms 9 (2011Po01, decay time distribution of β-delayed one-proton events), 21.1 ms 4 (2007Do17, decay time distribution), 21.6 ms 7 (2001Gi01, decay time distribution), 21 ms +4-3 (1992Bo37, decay time distribution).</p>

⁴⁵Fe 2p Decay (2.4 ms) 2012Au08,2009Mi29,2007Gi10

Parent ⁴⁵Fe: E=0; J π =(3/2+); T_{1/2}=2.4 ms 3; Q(g.s.)=1210 50; %2p decay=70 4.

⁴⁵Fe-Q(g.s.): From 2012Au08: Other: 1154 keV 16 (2012Wa38).

⁴⁵Fe-J: From systematics (2012Au07: NUBASE-2012).

⁴⁵Fe-T_{1/2}: Weighted average of 2.6 ms 2 (2007Mi36,2007Mi40, from decay time), 3.6 ms +16-8 (2012Au08,2007Gi10, determined by the time difference between implantation events and subsequent decay event), 1.6 ms +5-3 (2005Do20, from decay of the daughter activity), 3.2 ms +26-10 (2002Pf02, decay time distribution), 4.7 ms +34-14 (2002Gi09, decay time).

⁴⁵Fe-%2p decay: %2p=70 4, %ε+%β⁺=30 4 (2007Mi36,2007Mi40) Others: %2p=57 10 (2005Do20), 65% 5 (2008Bl03), 78 +14-22 (2012Au08).

2012Au08: visualization of two individual protons from a 2p decay mode. This study was a new analysis of data from the first observation of two proton decay data in ⁴⁵Fe that has already been presented in 2007Gi10. ⁴⁵Fe nuclei were produced in the reaction Ni(⁵⁸Ni,X) using the LISE3 separator at GANIL. ⁴⁵Fe ions were separated, identified and then implanted onto the time projection chamber (TPC). The identification was done by measuring energy loss in the first Si detector and tof between the micro-channel plate and the Si detector. Decays were detected in a time-projection chamber (TPC), where signals from four gas electron multipliers (GEM) detected in a two-dimensional strip detector combined with drift-time analysis were used to reconstruct the tracks of the particles in three dimensions. Characterization of the TCP was done with the β⁺p decay of ⁵²Ni with reference to proton energies and branching ratios. Measured energy loss, decay event counts, angular correlation between two protons. Deduced T_{1/2} of ⁴⁵Fe, branching ratio. Experimental T_{1/2} of ⁴⁵Fe was compared with predictions from three-body model. Implantation and decay events were time correlated with ten events were recorded for ⁴⁵Fe implantations and seven events recorded for the 2p decay of ⁴⁵Fe. Other recorded events in this study: β⁺ delayed one-proton decay (one event) and β⁺ delayed two-proton decay (two events). This study was a new analysis of data from the first observation of two proton decay data in ⁴⁵Fe that has already been presented in 2007Gi10.

2007Mi36, 2007Mi40, 2009Mi29: E=161 MeV/nucleon provided by the K500-K1200 coupled cyclotrons at the NSCL, MSU. ⁴⁵Fe ions were separated from other reaction products by the A1900 fragment separator. Decays of ⁴⁵Fe were detected using the Optical Time Projection Chamber (OTPC), consisting of parallel wire mesh electrodes and filled with a gas mixture of 66% He, 32% Ar, 1% N₂, 1% CH₄. Incoming ⁴⁵Fe ions and their decay products induce ionizing electrons along their trajectories which result in a camera signal, and a photo-multiplier signal which are used to reconstruct the particle momentum. Two dgf-4C modules record ΔE and time-of-flight information. Measured decay particle spectra, half-lives, branching ratios and angular and energy correlations between the two protons emitted from the ⁴⁵Fe ground state.

2007Gi10: ⁴⁵Fe nuclei produced in the reaction Ni(⁵⁸Ni,X) at the SSSI-ALPHA-LISE3 facility at GANIL. Two individual protons observed for the first time in a 2-proton decay mode using a time-projection chamber. Measured half-life and total decay energy. A total of ten ⁴⁵Fe implantations were recorded.

2005Do20: ⁴⁵Fe produced by fragmentation of a primary beam of ⁵⁸Ni at 74.5 MeV/nucleon with a natural Ni target. Fragments selected by α-LISE3 separator, the detection system for fragments and β particles consisted of four silicon detectors, time-of-flight technique. A total of 30 implantation events were assigned to ⁴⁵Fe. Also see 2005Bl31, 2005Gi15.

Others: 2011Bl01, 2009Bl06, 2008Mi03, 2007Gr12, 2007Gr13, 2006Ro09, 2005Pf01, 2005Pf02, 2004Bl05, 2004Bl19, 2004Pf02, 2003Bl21, 2003Gi13, 2003Pf01, 2002Gi09, 2002Pf02, 2002Pf03, 2001Gi01, 2001Gi02, 1992Bo37.

⁴³Cr Levels

E(level)	J π	T _{1/2}	Comments
0.0	(3/2+)	21.2 ms 7	J π ,T _{1/2} : from Adopted Levels. From two-proton emission from ⁴⁵ Fe, total decay energy=1.21 MeV 5 (2012Au08), in agreement with previous measurement of 1.151 MeV 15 (2008Bl03). The protons share equally the decay energy, and are emitted simultaneously (2012Au08).

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