		History	
Туре	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 140,1 (2017)	30-Sep-2015

 $Q(\beta^{-})=-1504.40\ 6$; $S(n)=9869\ 5$; $S(p)=12528.7\ 17$; $Q(\alpha)=-6800.69\ 19$ 2012Wa38

S(2n)=16467.71 19, S(2p)=22757 7 (2012Wa38).

First identification of ⁴⁰Ar nuclide by 1919As01 (later in 1921As01) in a mass spectrometer (2012Th10). Other reactions:

2012Zh06: ⁹Be(⁴⁰Ar,X), 181Ta(⁴⁰Ar,X) E=57 MeV/nucleon. Measured fragment yields.

2006LiZX: ${}^{9}Be({}^{38}S,X) E=5.45$ MeV/nucleon. Measured E γ , I γ .

1999Ma14: 40 Ar(μ -,X) E=125 MeV. Measured capture rates.

1996Ri19,1996Ri09: ⁴⁰Ar(¹⁶O,¹⁶O') E=250 MeV/nucleon. Deduced structure near isovector dipole and isoscalar quadrupole giant resonances.

1994An39: ${}^{36}S(\alpha,\alpha)$. Resonances were observed at E α =13320 (J^{π} =7⁻) and E α =14120 (J^{π} =8⁺).

1992Wa11,1991Mo05: 40 Ca(π -, π +) E=295 MeV. Deduced double isovector giant-dipole resonance at 31.1 MeV with a width of 90 MeV.

1990Va11: 40 Ar(X,X) E=5.9 keV. Measured E(x-ray).

1989A115: 40 Ar(32 S, 32 S) E=100 MeV. Measured $\sigma(\theta)$. 1989Gr06: E=180, 240 MeV; 1979Da16: E=290 MeV.

1986Ge01,1985Ge04: ⁴⁰Ar(π,π) E=180 MeV. Measured $\sigma(\theta)$.

1985Sh06: 40 Ar(16 O, 16 O) E=100 MeV. Measured $\sigma(\theta)$.

1983To18: 40 Ca(E, π +) E=400 MeV.

1980KoZI: ⁴⁸Ca(³He,¹¹Be). Deduced 8-particle transfer and isospin=4 isotopic multiplet.

Muonic x ray: 2p_{3/2} to 1s_{1/2}: 643.674 keV 20 (1981Fr25, 1992Fr01), 643.94 keV 11 (1971Bb11,1976Pf01).

Hyperfine structure and isotope shift measurements: 2008BeZH, 2005Bl33, 2003Sa20, 1996Kl04, 1988Mo30, 1986Mu06, 1982Ei01. Mass measurement: 2005Go36, 2003Fr08, 2002Bf02, 2001Wa50, 1998Ca53, 1997Br44, 1995Ya15, 1995Di08, 1968Sc01, 1968Fu11.

⁴⁰Ar Levels

Cross Reference (XREF) Flags

		$ \begin{array}{rcl} A & {}^{40}{\rm Cl}\beta^{-} \\ B & {}^{40}{\rm K}\varepsilonc \\ {\rm C} & {}^{12}{\rm C}({}^{36}{\rm S} \\ {\rm D} & {}^{26}{\rm Mg}({}^{11} \\ {\rm E} & {}^{26}{\rm Mg}({}^{11} \\ {\rm F} & {}^{36}{\rm S}(\alpha,\gamma \\ {\rm G} & {}^{37}{\rm Cl}(\alpha,; \\ {\rm H} & {}^{38}{\rm Ar}({\rm t}, {\rm p}) \end{array} $	decay (1.35 min) ecay (1.248×10 ⁹ y) ,2 $\alpha\gamma$) ² O,2 $p\gamma$), ²⁷ Al(¹⁸ O, $p\alpha\gamma$) ³ O,2 $p2n\gamma$)):resonances $p\gamma$)	I J K L M N O P	${}^{38}\text{Ar}(\alpha, {}^{2}\text{He})$ ${}^{40}\text{Ar}(\gamma, \gamma'), (\text{pol } \gamma, \gamma')$ ${}^{40}\text{Ar}(e, e'), (e, e)$ ${}^{40}\text{Ar}(n, n' \gamma), (n, n)$ ${}^{40}\text{Ar}(p, p' \gamma)$ ${}^{40}\text{Ar}(p, p'), (\text{pol } p, p')$ ${}^{40}\text{Ar}(pol \ d, d'), (d, d')$ ${}^{40}\text{Ar}({}^{3}\text{He}, {}^{3}\text{He}'), ({}^{3}\text{He}, {}^{3}\text{He})$	Ar($\alpha,^{2}$ He)Q 40 Ar(α,α'),(α,α)Ar(γ,γ'),(pol γ,γ')RCoulomb excitationAr(e,e'),(e,e)S 40 Ca(14 C, 14 O)Ar(n,n' γ),(n,n)T 41 K(d, 3 He)Ar(p,p' γ)U 42 Ca(14 C, 16 O)Ar(p,p'),(pol p,p')V 44 Ca(3 He, 7 Be)Ar(pol d,d'),(d,d')W 42 Ca($^{\alpha}, 2\alpha$)Ar(3 He, 3 He'),(3 He, 3 He)X 208 Pb(40 Ar,X γ)			
E(level) [†]	J ^{π#}	T _{1/2} @	XREF			C	Comments		
0 ^{<i>c</i>}	0+	stable	ABCDEFGHI JKLMNOPQ	RSTUV	WX J ^{π} : Optical spectroscop 1953Me73; no hyper Evaluated rms charge r $\Delta < r^2 > (^{38}Ar - ^{40}Ar) = 0.1$ (1986Mu06). charge radius $< r^2 >_{1/2} =$ (1971Bb11) from Mu (1976Fi12), 3.41 fm (19776ri27, 1975GrV)	y me. fine s adius 69 fr 3.415 uonic 4, (19	asurements: 1937Ko03, structure seen. =3.4274 fm 26 (2013An02). n ² 33 (1996K104), 0.17 fm ² 5 fm 5 (1976Pf01), 3.429 fm 6 x-ray data; 3.393 fm 15(stat) 971Sc09), 3.47 fm 5 48 fm 4 (1974Wo02) from		
1460.849 ^c 5	2+	1.15 ps 5	ABCDEFGHIJKLMNOPQ	RSTUV	⁴⁰ Ar(e,e') data. ⁴⁰ Ar(e,e') data. μ =-0.04 6 (2008Sp04, Q=+0.01 4 (1970Na05) J ^{π} : L(α , α')=L(t,p)=L(t,p)=L(t,p)	20148 ,2013 ool d,o	StZZ) StZZ) $d')=L(pol p,p')=L(d,^{3}He)=2.$		

⁴⁰Ar Levels (continued)

E(level) [†]	$J^{\pi \#}$	T _{1/2} @	Х	REF		Comments
						$T_{1/2}$: weighted average of 1.09 ps 28 from ³⁷ Cl(α,pγ), 1.11 ps 4 from ⁴⁰ Ar(e,e'), 1.35 ps 10 from ⁴⁰ Ar(p,p'γ) and 1.25 ps 14 from ¹² C(³⁶ S,2αγ). μ: using transient-field technique (2008Sp04). Others: -2 2 (1992Cu04), -0.03 8 (2005St22). Q: from reorientation in Coulomb Excitation (1970Na05).
2120.91 ^{<i>f</i>} 17	0+	104 ps 14	A C EFGH	LMNO Q	UVWX	$J^{\pi}: L(\alpha, \alpha') = L(p, p') = 0; \ 680\gamma(\theta) \text{ is isotropic from} $ (n,n' γ). T ₁ α : from p $\gamma(t)$ in (p,p' γ).
2524.09 ^{<i>f</i>} 11	2+	0.23 ps 4	A C EFGH K	KLMNO Q	ΤVΧ	J^{π} : $L(\alpha, \alpha') = L(\text{pol } q, d') = L(\text{pol } p, p') = 2.$ $T_{1/2}$: weighted average of 0.24 ps 4 from $(\alpha, p\gamma)$, 0.194 ps 35 from (e, e') and 0.34 ps 6 from $(p, p'\gamma)$. Others: 0.50 ps 8 from ${}^{36}S(\alpha, \gamma)$:resonances, 0.47 ps 7 from ${}^{12}C({}^{36}S(2\alpha\gamma))$
2892.65 ^c 9	4+	1.95 ps 28	A CDEFGHI	LMNO Q	VX	J ^{π} : L(α, α')=L(pol d,d')=L(pol p,p')=4. T _{1/2} : weighted average of 2.9 ps <i>14</i> from ²⁶ Mg(¹⁶ O,2p\gamma), 2.3 ps <i>6</i> from (α ,p γ), 1.80 ps 28 from ¹² C(³⁶ S,2 $\alpha\gamma$), and 3.0 ps + <i>18</i> -9 from (p p' α)
3207.93 13	2+	34 fs 7	AC FGH K	KLMNO Q	TUV X	(p, p'). J^{π} : L(t,p)=L(pol p,p')=2. $T_{1/2}$: weighted average of 28 fs 14 from $(\alpha, p\gamma)$ and 35 fs 7 from (e,e'). Others: 62 fs 12 from (α, γ) :resonances <24 fs from $(p, p'\gamma)$.
3464.56 ^c 12	6+	0.680 ns 21	DE GHI	Q	X	J^{π} : 571.88 γ E2 to 4 ⁺ , L(t,p)=(6).
3511.54 20	2+	59 fs 12	A FGH K	(MNO q	тvх	$I_{1/2}$: from $(\alpha, p\gamma)$. J^{π} : L(pol d,d')=L(d, ³ He)=2. $T_{1/2}$: weighted average of 62 fs <i>12</i> from (α, γ) :resonances, 49 fs <i>14</i> from $(\alpha, p\gamma)$ and 83 fs <i>31</i> from $(p, p'\gamma)$.
3515 ^{<i>f</i>} 1	4+	0.139 ps 28	E G	q		J^{π} : from $\gamma(\theta)$ in $(\alpha, p\gamma)$ and $\gamma(DCO)$ and band
3680.60 12	3-	0.132 ps 28	AC FGH K	(MNO Q	V X	J^{π} : $L(\alpha, \alpha') = L(\text{pol } d, d') = L(\text{pol } p, p') = 3.$ $T_{1/2}$: from $(\alpha, p\gamma)$. Other: 0.10 ps +6-5 from $(p, p'\gamma)$
3918.85 <i>12</i>	2+	0.29 ps 3	A FGH K	(MNoq		J ^{π} : 3918.6 γ E2 to 0 ⁺ , L(t,p)=L(pol p,p')=2. T _{1/2} : weighted average of 0.28 ps 3 from (α ,p γ) and 0.30 ps 4 from (p,p' γ).
3941.9? 2			Α	οq	W	XREF: A(?). $I_{\pi_{1}}^{\pi_{2}}$ (1.2 ⁺) from possible 3941 7a to 0 ⁺ a s
4042 2	NATURAL		FGH	MN Q	W	XREF: N(4053). E(level): from $(p,p'\gamma)$. J^{π} : 0 ⁺ , 1 ⁻ , 2 ⁺ , 3 ⁻ , 4 ⁺ from γ to 2 ⁺ and π =natural in $(\alpha \alpha')$
4082.63 16	3-	40 fs 14	A FGH	MN Q	W	J ^{π} : based on $\gamma(\theta, \text{pol})$ in $(\alpha, \text{p}\gamma)$ and $\text{p}\gamma(\theta)$ in $(p, p'\gamma)$, log $ft=5.9$ from 2 ⁻ in ⁴⁰ Cl β^- decay.
4178.9? 3 4230 2 4232 2	4 ⁽⁻⁾ (1 ⁺ ,2 ⁻ ,3 ⁺)	>2.8 ps 0.166 ps 28	A C G G	m mN Q		AKEF: A(?). J^{π} : based on $\gamma(\theta, \text{pol})$ in $(\alpha, p\gamma)$. XREF: N(4240). J^{π} : possible unnatural parity from (α, α') ; 1705 γ and 2768 γ to 2 ⁺
4301.08 23	(3)-	58 fs 14	A FGh	MN Q	u	J^{π} : log ft =5.1 from 2 ⁻ in ⁴⁰ Cl β ⁻ decay;

⁴⁰Ar Levels (continued)

E(level) [†]	$J^{\pi \#}$	$T_{1/2}^{(a)}$		Σ	KREF			Comments
4324.5 3	2+	16 fs 6	A	FGh		Q	Tu	possible natural parity in (α, α') ; L(p,p')=(2,3). XREF: T(4360). J ^{π} : L(d, ³ He)=0, L(t,p)=2. T ₁ (α) ; weighted average of 15 fs 6 from
4358.0 <i>3</i>			A		N	Q	u	³⁶ S(α, γ):resonances and 18 fs 7 from ($\alpha, p\gamma$). XREF: A(?)N(?). J ^{π} : π =(natural) from (α, α'), (1,2 ⁺) from possible
4420 <i>I</i>	(2+,3-)			G	MNO	q		4357.6 γ to 0 ⁺ g.s. XREF: N(4430). J ^{<i>π</i>} : 2959 γ , 1896 γ and 1212 γ to 2 ⁺ gives (0 ⁺ :4 ⁺); natural parity in (α, α') for 4420 and/or 4427 levels gives 1 ⁻ ,2 ⁺ ,3 ⁻ ,4 ⁺ ; L(pol d,d')=(2) gives
4427 1	(4 ⁺)	0.125 ps 21		GH		q		(2 ⁺); L(pol p,p')=3 gives 3 ⁻ . J ^{π} : L(t,p)=3,4; $\gamma(\theta,\text{pol})$ in $(\alpha,p\gamma)$ gives 3 ⁺ ,4,5 ⁺ ; 4 ⁻ ,5 ⁺ is ruled out by RUL for 2966 γ to 2 ⁺ .
4473 1	1&	0.070 eV 13		FG J	N			XREF: N(4484). J^{π} : from $\gamma(\theta)$ in (α, γ) :resoances, (γ, γ') and $(\alpha, p\gamma)$. $T_{1/2}$: from $(2l+1)\Gamma^{2}/\Gamma=0.21$ eV 4 with
4481.0 <i>3</i>	1-	<0.07 ps	A		М	Q		$\Gamma_0/\Gamma=1$ in (γ,γ') . XREF: A(?). J^{π} : from $\gamma(\theta)$ in $(p,p'\gamma)$; natural parity in (α,α') . $\Gamma_1(\alpha)$: from $(p,p'\gamma)$
4494 ^{<i>d</i>} 1	5-	0.50 ps 7	(CEGH				J^{π} : 1601 γ E1(+M2) to 4 ⁺ , 1029 γ d(+Q) to 6 ⁺ .
4562.36 16	$(1.3)^{-}$		А	G		0	т	$T_{1/2}$: from (α , $p\gamma$). XREF: T(4530).
	(-,-)							J^{π} : log $ft=5.4$ from 2 ⁻ in ⁴⁰ Cl β^- decay; possible natural parity in (α, α') .
4578 1	3(-)	37 fs 14	A	G	N	Q		XREF: A(?). J^{π} : 2 ⁺ ,3 is given by 1983Bi08 in (α ,p γ) based on $\gamma(\theta)$, but J^{π} =2 ⁺ should be ruled out since it results in ΔJ =2 for the 1685 γ to 4 ⁺ , which expects positive A ₂ value while the measured A ₂ by 1983Bi08 is negative. Natural parity in (α , α')
4602 1		53 fs 20		FG	N	Q		gives π =- for J=5. J ^{π} : 2078 γ and 3141 γ to 2 ⁺ ; possible natural parity in (α , α'). T _{1/2} : unweighted average of 73 fs 12 from
4674 1	(1+,2-,3+)	66 fs 17		GH	N	Q	u	(α, γ) resonances and 55 is 14 from $(\alpha, p\gamma)$. XREF: N(4683).
4737.8? 4			A			Q	u	J^{α} : 3213 γ to 2 ⁺ ; possible π =unnatural in (α , α'). XREF: A(?).
4769.0 <i>3</i>	1-	0.82 eV 6	A	GJ	N	Q		J ^{π} : (1,2 ⁺) from possible 4737.5 γ to 0 ⁺ g.s. J ^{π} : based on $\gamma(\theta, \text{pol})$ in (pol γ, γ') and $\gamma(\theta)$ in ($\alpha, p\gamma$); possible π =natural in (α, α'). T _{1/2} : from (2J+1) Γ_0^2/Γ =2.46 eV 17 with
4794 1	4+	52 fs 14		GH	N	Q		$T_{0/1} = T_{10} (Y, Y)$. XREF: N(4808).
4858 <i>1</i> 4870 <i>10</i>	5- 3-	37 fs 10		G H	NO	Q		J. 19017 M1+E2 to 4, $L(t,p)=3,4$. J ^{π} : 1965 γ E1(+M2) to 4 ⁺ , 1394 γ to 6 ⁺ . E(level): from (t,p). J ^{π} : L(pol d,d')=3: L(t,p)=3,4.
4901? <i>3</i> 4929 <i>1</i>	$(1^{-} \text{ to } 4^{+})$			J G	N			J^{π} : (1,2 ⁺) from possible 4901 γ to 0 ⁺ g.s. XREF: N(4941).

⁴⁰Ar Levels (continued)

E(level) [†]	J π #	T _{1/2} @		XI	REF			Comments
4942.6? <i>4</i>			А			a		J^{π} : 2405 γ and 3468 γ to 2 ⁺ and 1248 γ to 3 ⁻ . XREF: A(?).
4959 <i>f</i> 1	6+	0.10 ps 4		E Gh		q		J ^{π} : 1444 γ and 2066 γ E2 to 4 ⁺ ; γ (DCO) and band assignment in ²⁶ Mg(¹⁸ O 2p2p γ)
4972 <i>1</i>	$(2^+, 3, 4^+)$			Gh				J^{π} : 2079 γ to 4 ⁺ and 3511 γ to 2 ⁺ .
4991 <i>1</i>	4(-)	2.1 ps 7		G	N	Q		XREF: N(5004).
		Ĩ						J ^{π} : based on $\gamma(\theta, \text{pol})$ of 765 γ in $(\alpha, p\gamma)$, which implies a parity conserving transition to 4 ⁽⁻⁾ . But the parity is inconsistent with possible natural parity in (α, α') , which is π =+ for J=4.
5110? <i>3</i>				J				J^{π} : (1,2 ⁺) from possible 5110 γ to 0 ⁺ .
5115 2	(5 ⁻)			GH				J^{π} : L(t,p)=(5).
5143 2	(5)	<10 fs		G				J^{π} : 1628 γ to 4 ⁺ and 1678 γ to 6 ⁺ gives (4 ⁺ ,5,6 ⁺); T _{1/2} disfavors E2 for either transition.
5165.6 8	$(2)^{+}$		Α	G		Q	t	J^{π} : 1650y to 4 ⁺ and 3704.6y to 2 ⁺ ; natural parity in
								(α, α') favors (2,4) ⁺ ; L(d, ³ He)=0 from 3/2 ⁺ for a level at 5200 gives 1 ⁺ ,2 ⁺ ; (1,2 ⁺) from possible 5165.5 γ to 0 ⁺ .
5191 <i>15</i>				Н			t	E(level): from (t,p).
								J^{π} : L(d, ³ He)=0 from 3/2 ⁺ for a level at 5200 gives 1 ⁺ , 2 ⁺ .
5245 2	$(0^+ \text{ to } 4^+)$			G		~		J^{π} : 3784 γ to 2 ⁺ .
5269.6 3	(1,3)		A	G	n	Q	u	possible natural parity in (α, α') ; log $ft=5.9$ from 2 ⁻ in ⁴⁰ Cl β^- decay.
5293 2	(2^{+})			Gh	n		u	J^{π} : 3832 γ to 2 ⁺ ; L=2 for a level at 5298 15 in (t,p).
5310 2	(2 ⁺)		Α	Gh	n	Q	u	XREF: A(?). J ^{π} : possible natural parity from (α , α'); 1228 γ and 1629 γ to 3 ⁻ ; L=2 for a level at 5298 <i>15</i> in (t,p).
5350 2				G			u	J^{π} : 2457 γ to 4 ⁺ .
5378 2 5400.5 8	$(4^+,5,6^+)$ 1 ⁻	0.030 eV 7	A	G H J	N	Q		J^{π} : 1863 γ and 2485 γ to 4 ⁺ and 1913 γ to 6 ⁺ . XREF: N(?).
								J ^{π} : spin from $\gamma(\theta)$ in (γ, γ') ; natural parity in (α, α') . L(p,p')=(5) for a level at 5410 is inconsistent and it might imply that it is a different level.
								$T_{1/2}$: from $(2J+1)\Gamma_0^2/\Gamma=0.09$ eV 2 in (γ,γ') assuming $\Gamma_0/\Gamma=1$.
5454 15	3-,4+			H	N	Q		E(level): from (t,p). $I^{n}: L(t,p)=3.4$.
5508 2	NATURAL			GH		Q		J^{π} : natural parity from (α, α') : 1993 γ to 4 ⁺ .
5544 2	$(0^+ \text{ to } 4^+)$			G				J^{π} : 4083 γ to 2 ⁺ .
5559 2	(4 ⁺ ,5 ⁻ ,6 ⁺)			G		Q		J ^{π} : 2044 γ and 2666 γ to 4 ⁺ and 2094 γ to 6 ⁺ ; natural parity in (α, α').
5608.8 10	(1,2,3)		A	G		q		J ^{π} : 4147.8 γ to 2 ⁺ ; log <i>ft</i> =6.3 from 2 ⁻ in ⁴⁰ Cl β ⁻ decay; possible natural parity in (α , α') for a group near 5608.
5611 2				G		q		J^{π} : 2147 γ to 6 ⁺ .
5630 1			A	G		q		XREF: A(?).
5654 2				C				J ^{<i>n</i>} : 1203 γ to (4 ⁺); possible natural parity from (α, α') for a doublet.
5652 2				G	~			J ^{**} : 5150γ to 2 ⁺ . $I^{\pi_{+}}$ 2760 α to 4 ⁺
5675 2	$(3^{-}4^{+})$			GH	n	0		I^{π} : L(t n)=3.4: possible natural parity in $(\alpha \alpha')$
5717.8? 10	(3,1)		Α	011	n	Q	w	\bullet . $\Sigma(x,p)=0, \tau, possible initial party in (x,x).$

⁴⁰Ar Levels (continued)

E(level) [†]	$J^{\pi \#}$	$T_{1/2}^{(a)}$		XI	REF			Comments
5766 2 5818 2	(3 ⁻ ,4 ⁺)			G GH		Т	W W	J^{π} : 2558 γ to 2 ⁺ . XREF: H(5835). I^{π} . L(t p)=3.4
5880.3 4	1-	0.117 eV <i>13</i>	A	J	οq			J^{π} : log $ft=4.9$ from 2 ⁻ in ⁴⁰ Cl β^- decay; spin=1 from $\gamma(\theta)$ in (γ,γ') . $T_{1/2}$: from $(2J+1)\Gamma_0^2/\Gamma=0.35$ eV 4 in (γ,γ')
5885 2	3-			GH	No q			assuming $\Gamma_{0/1} = 1$. XREF: N(5900). J^{π} : L(pol p,p')=3; L(pol d,d')=(3). But L(t,p)=2 for a level at 5883 /5 is inconsistent
5906.0 7	(1 ⁻)		A		q			J^{π} : 3784.9 γ to 0 ⁺ ; log <i>ft</i> =5.8 from 2 ⁻ in ⁴⁰ Cl β^{-} decay; possible natural parity in (α, α').
5912 <i>3</i>	1&	0.050 eV 17		J	q			E(level): a level at the same energy is also observed in $(\alpha, p\gamma)$ but with completely different decay mode and it is considered by evaluator as a separate level. $T_{1/2}$: from $(2J+1)\Gamma_0^2/\Gamma=0.15$ eV 5 in (γ, γ') assuming $\Gamma_0/\Gamma=1$
5912 2 5931 2 5950.5 10	$(1^{-} \text{ to } 4^{+})$ $(2^{+},3,4^{+})$ (1,2)		A	G G	q			J^{π} : 1830y to 3 ⁻ and 2704y to 2 ⁺ . J^{π} : 3038y to 4 ⁺ and 4470y to 2 ⁺ . J^{π} : 5950.0y to 0 ⁺ ; log <i>ft</i> =6.9 from 2 ⁻ in ⁴⁰ Cl β^{-}
5973 ^e 2	(6 ⁻)			EG				J^{π} : from (α ,p γ) based on analog in ⁴² Ca, and from γ (DCO) in ²⁶ Mg(¹⁸ O,2p2n γ).
6013 ^d 2	(7 ⁻)			EG				J ^{π} : from (α ,p γ) based on analog in ⁴² Ca, and from γ (DCO) and band assignment in ²⁶ Mg(¹⁸ O,2p2n γ).
6053.6 8	1(-)	0.41 eV 6	Α	J	q			J ^{π} : spin from $\gamma(\theta)$ in (γ, γ') ; log $ft=5.9$ from 2 ⁻ in ⁴⁰ Cl β^- decay.
6054	4+				0 q			T _{1/2} : from $(2J+1)\Gamma_0^2/\Gamma=1.24$ eV <i>19</i> in (γ,γ') assuming Γ ₀ /Γ=1. E(level): as quoted in 1976Se09 in (pol d,d'). A level at the same energy is also observed in ⁴⁰ Cl β ⁻ decay and (γ,γ') but with $J^{\pi}=1^{(-)}$. Therefore it is
6100 2	(1,2+)			GJ				J ^π : L(pol d,d')=4. J ^π : based on $\gamma\gamma(\theta)$ in (γ,γ') and 6100 γ to 0 ⁺ . Γ ₀ =0.22 eV 6 for J(6100)=1 and 0.13 eV 4 for J(6100)=2 from (2J+1)Γ ₀ ² /Γ=0.17 eV 5 in (γ,γ')
6104 2 6138 2			A	G GH	N Q			with $\Gamma_0/\Gamma=0.26$. J^{π} : 3211 γ to 4 ⁺ . XREF: A(?). J^{π} : 2674 γ to 6 ⁺ , but L=(2,3) in (p,p') and L (t p)=(5) are inconsistent
6158 2 6185 2 6203 2	(4+,5,6+)			G G G	q	Т		J^{π} : 2693y to 6 ⁺ and 3265y to 4 ⁺ . J^{π} : 1691y to 5 ⁻ . XREF: T(6230). I^{π} : 3310y to 4 ⁺ : natural parity in ($\alpha \alpha'$)
6208.5 8	(1,2)		A		q			J^{π} : 6208y to 0 ⁺ ; log <i>ft</i> =6.6 from 2 ⁻ in ⁴⁰ Cl β^{-}
6270 2 6276.0? 9	1-,2-,3-		A	G	n n			J^{π} : 2806 γ to 6 ⁺ . XREF: A(?).
6305 2	(4+,5,6+)			GH	n			J^{π} : 2790 γ to 4 ⁺ and 2840 γ to 6 ⁺ .

⁴⁰Ar Levels (continued)

E(level) [†]	J ^{π#}	T _{1/2} @		X	REF	Comments
6338.7 11	1-	0.29 eV 3	A	J		J ^{π} : spin from $\gamma\gamma(\theta)$ in (γ,γ') ; log $ft=5.6$ from 2 ⁻ in 40 Cl β^{-} decay
						$T_{1/2}$: from $(2J+1)\Gamma_0^2/\Gamma=0.87$ eV 10 in (γ,γ') with $\Gamma_0/\Gamma=1$.
6356 2	(4 ⁺ to 7 ⁻)			G		J^{π} : 1498 γ to 5 ⁻ and 2891 γ to 6 ⁺ .
6421 [‡]	(8 ⁻) ^b			E		
6450? 3	1-	0.42 11 5		J		
6476.08	1	0.43 eV 5	A	ΗJ	N	J ^(*) : spin from $\gamma\gamma(\theta)$ in (γ,γ') ; log $ft=5.6$ from 2 in 40 Cl β^- decay. L(t,p)=(2) is inconsistent. T _{1/2} : from $(2J+1)\Gamma_{\alpha}^2/\Gamma=1.29$ eV 16 in (γ,γ') with
						$\Gamma_0/\Gamma=1.$
6651.7 8	87		Α	Н	N	XREF: A(?)N(6650).
6703 3	1^{α}			J		$\mathbf{E}(\mathbf{a}_{i})$ from (t, \mathbf{n})
0700 15	5,4			п		J^{π} : L(t,p)=3,4.
6806 <i>f</i>	(8 ⁺)			EG		E(level): from $(\alpha, p\gamma)$. Other: 6801 from
						26 Mg(18 O,2p2n γ).
						J ^{π} : from γ (DCO) and band assignment in ²⁶ Mg(¹⁸ O,2p2n γ); possible analog state of ⁴² Ca (1983Bi08) from (α p γ)
6835 15	3-,4+			Н		E(level): from (t,p).
						J^{π} : L(t,p)=3,4.
6979 ^e	(8 ⁻)			EG		J ^{π} : from γ (DCO) and band assignment in ²⁶ Mg(¹⁸ O,2p2n γ); possible analog state of ⁴² Ca (1983Bi08) from (α p γ)
7070 15				Н		E(level): from (t,p).
7168 <i>3</i>	1&			НJ		
7246 <i>3</i>	1 &			J		
7281 <i>3</i>	1 ^{&}			ΗJ	N	XREF: H(7300)N(7300).
7519 <i>3</i>	1&			ΗJ		XREF: H(7495).
7626 3	1			J		
7640 15	2*			Н		E(level): from (t,p). J^{π} : L(t,p)=2.
7688 ^{‡d}	(9 ⁻) ^b			E		
7708 <i>3</i>	1- &			J		
7730 3	. <i>8</i> 7			Н		E(level): from (t,p).
7918 2	1-&			HJ		XREF: H(7890).
7993 3	1°			EHJ		XREF: H(7980).
2022 2	$(10)^{*}$			E		
8032 3 8163 2	1 - &			J		
8105 2	1 1-&			ן ז		
8303 3	1 1-&			ן ז		
8552.3	1-&			J 1		
8585 3	1-&			1		
8644 3	1-&			1		
8676.3	1.2+ &			Ĵ		
8834 4	1 ⁻ &			J		

⁴⁰Ar Levels (continued)

E(level) [†]	J [#]	T _{1/2} @	XREF	Comments
8884 <i>3</i>	1-&		J	
8918 <i>3</i>	1 ^{-&}	0.34 eV 14	F iJ	T _{1/2} : from (γ, γ') .
8946 ^{‡d}	(11 ⁻) ^b		E	
9070 [‡]	$(10^{+})^{b}$		E	
9127 3	$1^{-\infty}$	0.71 eV 14	F iJ	T _{1/2} : from (γ, γ') . 0.72 eV 16 from ³⁶ S (α, γ) :resonances.
9138 6	$(1,2^{+})^{\alpha}$ 1^{-a}		F	
9178 3	1^{1-a}		F	
9197 6	$(1^{-},2^{+})^{a}$		F	
9216 4	1^{-a}		F	
9234 4	1^{-a}		F	
9240 0 9264 4	$(1^{-},2^{+})^{a}$		F	
9273 6	1^{-a}		F	
9287 4	(1 - 2 +)		F	
9296 5	$(1^{-},2^{+})^{\alpha}$		F	
9314 <i>4</i> 9330 <i>4</i>	1^{-a}		F J F	
9337 3	1^{1-a}		FJ	
9355 <i>3</i>	1- & a	1.0 eV 3	FJ	$T_{1/2}$: from (γ, γ') . 1.1 eV 3 from (α, γ) :resonances.
9373 4			F	
9416 3	1-&a	3.4 eV 18	FJ	E(level): doublet: 9408+9417 in (α, γ) with same J^{π} for both; the second component seems to correspond to 9416 in (γ, γ') .
0425 5	(1 - 2 +)		T.	T _{1/2} : from (γ, γ') . 4.0 eV 20 from ³⁰ S (α, γ) :resonances.
9425 5	$(1^{-},2^{+})^{a}$		F	
9450 3	1^{-a}		F	
9472 4	$(1^{-},2^{+})^{a}$		F	
9485 5 94912	1-4		F	
9504 2 14	1-&a	79 eV 13	FI	T _{1/2} : from (γ, γ') 8.2 eV 18 from ${}^{36}S(\sigma, \gamma)$:resonances
9527 4	1	1.9 01 15	F	$\Gamma_{1/2}$. Hold (γ, γ) . 0.2 eV 10 Hold $O(\alpha, \gamma)$. Resonances.
9565 4	1 ^{-a}		F	
9583 <i>3</i>	1-&a	7.3 eV 21	FJ	E(level): doublet:9581+9586 in (α, γ) , 9580+9585 in (γ, γ') ; the second component has $J^{\pi} = (1^{-}, 2^{+})$ in (α, γ) .
0506 /			F	$T_{1/2}$: from (γ, γ') .
9608 5			F	
9617 <i>3</i>	1- & a		FJ	
9656 4	1 ^{-a}		F	
9669 4	1^{-a}		F	
9690 5	$(1^-, 2^+)^{tt}$		F	E(level), J^{n} : doublet: 9687+9694 with the same J^{n} for both.
9736 <i>3</i>	1^{-a}		F	
9757 <i>3</i>	1+ &	0.56 eV 22	FJ	J^{π} : $(1^{-}, 2^{+})$ from $\gamma(\theta)$ and natural parity in (α, γ) :resonances.
9769 4	$(1^{-} 2^{+})^{a}$		F	$1_{1/2}$: from (γ, γ') .
9787 4	1^{-a}		F	

⁴⁰Ar Levels (continued)

E(level) [†]	J ^{π#}	T _{1/2} @		XREF		Comments
9813 <i>3</i>	1 ^{-a}		F			
9825 <i>3</i>	1 ^{-a}		F			
9840 <i>3</i>	1- &			J		
9851 2	1- & a	21 eV 4	F	J		E(level): doublet: 9849+9852 in (α, γ) .
00// 1						$T_{1/2}$: from (γ, γ') . 22 eV 6 from ${}^{50}S(\alpha, \gamma)$:resonances.
9866 4	1-a		r E			
9881 4	1^{-a}		r F			
9012 5	$(1^{-} 2^{+})^{a}$		г F			
9944 3	1^{-a}		F			
9952 3	1- &	10 eV 3	F	J		E(level): weighted average of 9954 3 from (α, γ) , 9950 3 from (γ, γ') .
						$T_{1/2}$: from (γ , γ'). ≥9.6 eV from ³⁶ S(α , γ):resonances.
10090 <i>3</i>	1- &			J		
10151 <i>3</i>	1- &			J		
10179 2	1- &			J		
10362.3	1.2+ &			1		
10745 3	1, - &			1		
10857 3	1-&			1		
$11760 \ddagger f$	$(12^{+})^{b}$		F	2		
17.09.0 $17.7 \times 10^3 2$	2^+		L		Q	E(level), J^{π} : isoscalar giant-quadrupole resonance with $L(\alpha, \alpha')=2$.

[†] From a least-squares fit to γ -ray energies if values with uncertainties are available, otherwise, from (α ,p γ) up to 6979 level and from (α , γ):resonances after 8919 level if available, unless otherwise noted.

[‡] From ${}^{26}Mg({}^{18}O,2p2n\gamma)$.

[#] In (d,³He) reaction, ⁴¹K target $J^{\pi}(g.s.)=3/2^+$.

^(a) Values of half-lives are from $(\alpha, p\gamma)$, unless otherwise noted; widths are from (γ, γ') and/or (α, γ) . Some half-lives are also available from $(p, p'\gamma)$ and (α, γ) and weighted averages are taken when values are from more than one reactions. In addition to the width values from (γ, γ') given here for levels with known γ -decay branching ratios, width data for other levels (mostly α -unbound) with unknown γ -decay branching ratios are also available in that dataset.

- & From (γ, γ') , based on $\gamma(\theta)$ in (γ, γ') , parity from polarization asymmetry if available.
- ^{*a*} From (α, γ) :resonances, based on $\gamma(\theta)$ and natural parity.
- ^b From ²⁶Mg(¹⁸O,2p2n γ) based on γ (DCO) and band assignment.
- ^{*c*} Band(A): Member of $f_{7/2}^2$ yrast sequence.
- ^d Band(B): Band based on 5⁻, $\alpha = 1$.
- ^e Band(C): Band based on (6⁻), α =0.
- ^{*f*} Band(D): SD band. Q(transition)=1.45 +49-31(stat) 15(syst) (2010Id02) from ²⁶Mg(¹⁸O,2p2n\gamma). Possible configuration= $\pi[(d5/2)^{-1.2}(s_{1/2}d_{3/2})^{-3.8}$ (fp)^{2.5}(g_{9/2})^{0.5}] $\otimes \nu[(d5/2)^{-0.7}(s_{1/2}d_{3/2})^{-2.4}$ (fp)^{4.5}(g_{9/2})^{0.5}].

γ (⁴⁰Ar)

E _i (level)	\mathbf{J}_i^{π}	E_{γ}^{\dagger}	$I_{\gamma}^{\#}$	E_f	\mathbf{J}_f^{π}	Mult. [@]	$\delta^{@}$	Comments
1460.849	2+	1460.820 5	100	0	0+	E2		B(E2)(W.u.)=9.0 4 E_{γ} : from ⁴⁰ K ε decay. Other: 1460.73 5 from ⁴⁰ Cl β^{-} decay. Mult.: from $\gamma(\theta, \text{pol})$ in ²⁶ Mg(¹⁶ O,2p γ), $\gamma(\theta)$ in ⁴⁰ Ar(p,p' γ) and ce data in ⁴⁰ K ε decay.
2120.91	0^+	660.1 4	100	1460.849	2+	[E2]		B(E2)(W.u.)=5.3 8 E_{γ} : from ⁴⁰ Cl β^- decay.
2524.09	2+	403 ^{&} 1063.1 2	<1.7 100 2	2120.91 1460.849	0+ 2+	M1+E2	-0.41 +6-13	E _γ ,I _γ : from ⁴⁰ Ar(p,p'γ). B(M1)(W.u.)=0.037 6; B(E2)(W.u.)=18 5 I _γ : from ³⁷ Cl(α,pγ). Others: 100 10 from ⁴⁰ Cl β ⁻ decay, and 100 3 from ⁴⁰ Ar(p,p'γ).
		2524.1 2	74 2	0	0+	E2		Mult., δ : from (p,p' γ). B(E2)(W.u.)=1.19 <i>18</i> I _{γ} : weighted average of 86 <i>10</i> from ⁴⁰ Cl β^- decay, 75.4 <i>18</i> from ³⁷ Cl(α ,p γ), and 69 <i>3</i> from ⁴⁰ Ar(p,p' γ).
2892.65	4+	369.0 <i>6</i> 1431.82 <i>10</i>	1.0 5 100 <i>10</i>	2524.09 1460.849	2+ 2+	[E2] E2		Mult.: Q from $(p,p'\gamma)$; M2 is ruled out by RUL. B(E2)(W.u.)=5×10 ¹ 3 B(E2)(W.u.)=5.9 9 E _{γ} : weighted average of 1432.1 4 from ⁴⁰ Cl β^- decay and 1431.80 10 from ${}^{37}Cl(\alpha,p\gamma)$. Additional information 1.
3207.93	2+	315.0 <i>5</i> 1087.6 <i>4</i> 1746.5 <i>2</i>	0.9 <i>3</i> 3.0 <i>15</i> 100 <i>1</i>	2892.65 2120.91 1460.849	4+ 0+ 2+	[E2] [E2] M1+E2	+0.11 7	Mult.: from $\gamma(\theta, \text{pol})$ in ${}^{26}\text{Mg}({}^{16}\text{O}, 2p\gamma)$, $\gamma(\theta)$ in $(p, p'\gamma)$; M2 is ruled out by RUL. B(E2)(W.u.)=5.1×10 ³ 21 is much higher than allowed by RUL. B(E2)(W.u.)=35 19 B(M1)(W.u.)=0.104 22; B(E2)(W.u.)=1.3 +17-13 I _{\gamma} : from ${}^{37}\text{Cl}(\alpha, p\gamma)$. Others: 100 9 from ${}^{40}\text{Cl}\beta^-$ decay and 100 3 from ${}^{40}\text{Ar}(p, p'\gamma)$. Mult., δ : D+Q from $\gamma(\theta)$ in $(p, p'\gamma)$, polarity from no level-parity change
		3208.2 3	11.7 <i>16</i>	0	0^+	[E2]		determined from other evidence. B(E2)(W.u.)=0.61 <i>16</i> I_{γ} : weighted average of 18 3 from ⁴⁰ Cl β^- decay, 11.1 <i>11</i> from ³⁷ Cl(α ,p γ),
3464.56	6+	571.91 8	100	2892.65	4+	E2		and 10 3 from ⁴⁰ Ar(p,p' γ). B(E2)(W.u.)=1.67 6 E _{γ} : from (α ,p γ). Mult.: from $\gamma(\theta$,pol) in ²⁶ Mg(¹⁶ O,2p γ), $\gamma(\theta)$ in (α ,p γ); M2 is ruled out by
3511.54	2+	303.0 <i>6</i> 621.1 <i>6</i>	3.2 <i>18</i> 2 <i>2</i>	3207.93 2892.65	2+ 4+	[E2]		KUL. I _γ : weighted average of 5 3 from ⁴⁰ Cl β ⁻ decay and 2.2 23 from ⁴⁰ Ar(p,p'γ). B(E2)(W.u.)= $2.0 \times 10^2 + 21 - 20$ I _γ : from (α,pγ).

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						A	dopted Levels,	Gammas (continued)
							γ (⁴⁰ Ar)	(continued)
E _i (level)	\mathbf{J}_i^{π}	E_{γ}^{\dagger}	$I_{\gamma}^{\#}$	E_f	\mathbf{J}_{f}^{π}	Mult. [@]	$\delta^{@}$	Comments
3511.54	2+	987 2050.5 <i>4</i>	6.2 <i>12</i> 100 <i>2</i>	2524.09 1460.849	$\frac{2^{+}}{2^{+}}$	M1(+E2)	-0.05 11	I _γ : from (α,pγ). B(M1)(W.u.)=0.034 7 I _γ : from ⁴⁰ Ar(p,p'γ). Others: 100 15 from ⁴⁰ Cl β ⁻ decay, 100 4 from 37 Cl(α,pγ).
		3511.0 5	14.7 <i>17</i>	0	0+	[E2]		Mult., δ : D(+Q) from $\gamma(\theta)$ in (p,p' γ), polarity from no level-parity change determined from other evidence. B(E2)(W.u.)=0.26 δ I _{γ} : weighted average of 15 δ from ⁴⁰ Cl β^- decay, 17.3 25 from ³⁷ Cl(α ,p γ), and
3515	4+	622	52 <i>3</i>	2892.65	4+	M1(+E2)	-0.07 10	$12.4 23 \text{ from (Ar(p, p' \gamma))}.$ B(M1)(W.u.)=0.20 5
		991 2054	15 8 100 <i>3</i>	2524.09 1460.849	$2^+_{2^+}$	[E2] [E2]		Mult., δ : D(+Q) from $\gamma(\theta)$ in $(\alpha, p\gamma)$; E1(+M2) ruled out by RUL. B(E2)(W.u.)=5×10 ¹ 3 B(E2)(W.u.)=8.2 <i>18</i>
3680.60	3-	170 ^{&} 472.0 <i>4</i> 788.1 <i>3</i>	<8 3.5 <i>12</i> 11.9 <i>12</i>	3511.54 3207.93 2892.65	$2^+ 2^+ 4^+$	[E1] [E1]		E_{γ}, I_{γ} : from $(p, p'\gamma)$. B(E1)(W.u.)=0.0012 5 B(E1)(W.u.)=0.00086 21
		1156.2 4	5.2 7	2524.09	2+	[E1]		I _γ : weighted average of 11.6 <i>12</i> from ⁴⁰ Cl β ⁻ decay, 11.6 <i>12</i> from ³⁷ Cl(α,pγ), and 18 4 from ⁴⁰ Ar(p,p'γ). B(E1)(W.u.)=0.00012 3 I _γ : weighted average of 7.0 <i>12</i> from ⁴⁰ Cl β ⁻ decay, 4.7 6 from ³⁷ Cl(α,pγ), and
		2220.0 2	100 2	1460.849	2+	E1(+M2)	-0.07 +5-11	7 4 from ${}^{40}\text{Ar}(p,p'\gamma)$. B(E1)(W.u.)=0.00032 7 I _{γ} : from ${}^{37}\text{Cl}(\alpha,p\gamma)$. Others: 100 14 from ${}^{40}\text{Cl}\beta^-$ decay, and 100 4 from ${}^{40}\text{Ar}(p,p'\gamma)$.
3918.85	2+	3681 ^{&} 239.0 <i>3</i>	<6 1.4 8	0 3680.60	0+ 3-	[E3] [E1]		 Mult.,δ: D(+Q) from pγ(θ) in (p,p'γ), polarity from level-parity change determined from other evidence. B(E3)(W.u.)<3×10² B(E1)(W.u.)=0.0012 7 E_γ: from ⁴⁰Cl β⁻ decay, observed in (p,p'γ) but not in (α,pγ). L_γ: scaled from I_γ(2457.7)=30 3 from (α,pγ) by the factor of
		1394.7 <i>3</i> 1797.8 2	22 <i>3</i> 15 <i>3</i>	2524.09 2120.91	$2^+_{0^+}$	[E2]		I _γ (239.0)/I _γ (2457.7)=4.8 23/100 17 from ⁴⁰ Cl $β^-$ decay. I _γ : from (α,pγ). Others: 13.6 17 from (p,p'γ), 26 4 from ⁴⁰ Cl $β^-$ decay. B(E2)(W.u.)=1.1 3
		2457.7 4	30 <i>3</i>	1460.849	2+	M1+E2		 I_γ: from (α,pγ). Others: 20 3 from (p,p'γ), 47 7 from ⁴⁰Cl β⁻ decay. I_γ: from (α,pγ). Others: 36 5 from (p,p'γ), 100 <i>17</i> from ⁴⁰Cl β⁻ decay. Mult.: D+Q from γ(θ) in (p,p'γ), polarity from no level-parity change determined from other evidence.
		3918.6 2	100 7	0	0^+	E2		$ δ: <-0.3 \text{ or }>+6 \text{ from } (p,p'\gamma). $ B(E2)(W.u.)=0.154 21 I _γ : from (α,pγ). Others: 100 5 from (p,p'γ), 83 9 from ⁴⁰ Cl β ⁻ decay. It is seen

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 $^{40}_{18}\mathrm{Ar}_{22}$ -10

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					I	Adopted L	evels, Gammas	(continued)
						γ	(⁴⁰ Ar) (continue	bd)
E_i (level)	\mathbf{J}_i^π	E_{γ}^{\dagger}	${\rm I_{\gamma}}^{\#}$	\mathbf{E}_{f}	\mathbf{J}_f^{π}	Mult. [@]	$\delta^{@}$	Comments
								from the gamma spectrum in 1972K106 in ⁴⁰ Cl β^- decay that the 3919 single–escape–peak+full–energy–peak is much stronger than the 2458 peak. It is possible that the intensity of 3919 single-escape peak is not taken into account for the total intensity of the 3919 gamma-ray by 1972K106. Mult.: Q from $\gamma(\theta)$ in (p,p' γ); M2 is ruled out by RUL.
3941.9?		3941.7 <mark>&</mark> 2	100	0	0^{+}			
4042	NATURAL	1518 2	100 16	2524.09	2+			E_{γ} : from (p,p' γ). I_{γ} : from ³⁶ S(α,γ):resonances. Other: 100 22 from ⁴⁰ Ar(p,p' γ).
		2581	62 16	1460.849	2+			I _{γ} : weighted average of 59 <i>16</i> from ³⁶ S(α,γ):resonances and 67 22 from ⁴⁰ Ar(p,p' γ).
4082.63	3-	1558.7 4	3.3 4	2524.09	2+	[E1]		B(E1)(W.u.)=0.00012 5
		2621.7 2	100 9	1460.849	2^{+}	[E1]		B(E1)(W.u.)=0.0008 3
		4082.1.8	1.7.3	0	0^{+}	IE3		$B(E3)(W,u) = 2.7 \times 10^2 11$
4179.02		4170 7 & 2	100	Ő	0+	[20]		
4176.91	A(-)	41/0./ 5	100	2690.60	0	DIO	10 . 2 0	
4230	4	5472	89 4	3680.60	3	D+Q	-10 + 3 - 9	E_{γ} : from (p,p' γ).
		1220.2	100 1	2202 (5	4+	$\mathbf{D}(\mathbf{x}, \mathbf{O})$	$\cdot 0 \leftarrow 1 = 0$	Mult., ϕ : based on $\gamma(\theta, poi)$ in $(\alpha, p\gamma)$.
		1558 2	100 4	2892.05	4	D(+Q)	+0.0 + 4 - 8	Mult., σ : based on $\gamma(\theta)$ in $(\alpha, p\gamma)$.
4020	(1 + 2 - 2 +)	1709 3	100 4	2524.00	2^+			E_{γ} : from (p,p' γ).
4232	$(1^{+}, 2^{-}, 3^{+})$	1708 2	100 4	2524.09	2 · 2+			E_{γ} : from (p,p γ).
4201.09	$(2)^{-}$	2//1	30 4	1460.849	2.			
4301.08	(3)	021.1 0	<0.9	3080.00	3			
		1092.9 8	1.0 2	3207.93	21	[EI]		$B(E1)(W.u.)=8\times10^{-5}$ 3
		1776.9 8	0.06 1	2524.09	2+	[E1]		$B(E1)(W.u.)=1.1\times10^{-6} 4$
		2840.1 <i>3</i>	100 15	1460.849	2+	[E1]		$B(E1)(W.u.) = 0.00043 \ 14$
4324.5	2+	2864	43 9	1460.849	2+			I _γ : from from ³⁰ S(α , γ):resonances. Not seen in ⁴⁰ Cl β^- decay. Other: 100 7 from (α ,p γ).
		4324.2 <i>3</i>	100 9	0	0^{+}	[E2]		B(E2)(W.u.)=0.8 4 I _{γ} : from ³⁶ S(α,γ):resonances. Other: 41 7from ($\alpha,p\gamma$).
4358.0		4357.6 <mark>&</mark> 3	100	0	0^{+}			,
4420	$(2^+,3^-)$	1212	11 2	3207.93	2^{+}			
	(_ ,=)	1896	10.2	2524.09	$\frac{-}{2^{+}}$			
		2959	100 5	1460 849	$\frac{-}{2^+}$			E_{x} : 2958 3 from (n p' γ)
4427	(4^{+})	1534	75.9	2892.65	$\frac{2}{4^{+}}$	D+O		Mult : from (α, p_{γ}) based on $\gamma(\theta)$
	()	1551	157	2072.03	'	PIQ		δ : -0.2 to +1.0 from (α pv) based on $\gamma(\theta)$
		2966	100.9	1460 849	2^{+}	[E2]		$B(E2)(W_{II}) = 1.4.3$
4473	1	4473 3	100	0	$\tilde{0}^{+}$	[22]		
4481.0	1-	4480 7 3	100	0	0^{+}	D		Mult : based on $\gamma(\theta)$ in $(n n' \gamma)$
1/0/	5-	264	305	1230	$A^{(-)}$	D		I : from (αm)
4474	5	204	5.0 5	7230	+` ´			1γ . Itom $(\alpha, \gamma\gamma)$.

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 $^{40}_{18}\mathrm{Ar}_{22}$ -11

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 $^{40}_{18}\mathrm{Ar}_{22}$ -11

From ENSDF

					Ad	lopted Level	s, Gammas (con	tinued)			
γ ⁽⁴⁰ Ar) (continued)											
E _i (level)	\mathbf{J}_i^{π}	E_{γ}^{\dagger}	$I_{\gamma}^{\#}$	E_f	\mathbf{J}_f^{π}	Mult. [@]	$\delta^{@}$	Comments			
4494	5-	979	15 2	3515	4+	[E1]		B(E1)(W.u.)=0.000113 23			
		1029	46 <i>3</i>	3464.56	6+	D(+Q)	+0.06 +7-10	I_{γ} : from (α ,p γ). I_{γ} : from (α ,p γ).			
		1601	100 5	2892 65	4 ⁺	F1(+M2)	0.00 + 6 - 9	Mult., δ : from (α , $p\gamma$), based on $\gamma(\theta)$. B(E1)(Wu)=0.00017.3			
		1001	100 5	2072.05	·		0.00 10 9	I_{γ} : from (α ,p γ). Mult δ_{1} from (α ,p γ).			
4562.36	(1,3)-	261.2 7	7.1 7	4301.08	(3)-			Mult., o . from $(a,p\gamma)$, based on $\gamma(o,por)$.			
		479.9 <i>4</i>	7.9 14	4082.63	3-			I_{γ} : other: 18.4 21 from $(\alpha, p\gamma)$.			
		643.6 <i>3</i>	59 <i>4</i>	3918.85	2^{+}			I_{γ} : other: 86 8 from $(\alpha, p\gamma)$.			
		881.3 <i>3</i>	22.9 22	3680.60	3-						
		1051.1 5	4.3 7	3511.54	2+						
		1353.7 5	1.8 7	3207.93	2+						
		3101.7 4	100 14	1460.849	2+			I_{γ} : other: 100 8 from (α ,p γ).			
4578	3(-)	222.5 <mark>&</mark> 5		4358.0				E_{α} : observed only in ⁴⁰ Cl β^- decay.			
	-	1067	90 10	3511.54	2^{+}			= = = = =			
		1370	38.5	3207.93	$\frac{-}{2^{+}}$						
		1685	100 10	2892.65	4+	D+O		Mult.: based on $\gamma(\theta)$ in $(\alpha, p\gamma)$.			
								δ : -0.05 to +0.72 for J=3 based on $\gamma(\theta)$ in $(\alpha, p\gamma)$.			
		3117	28 5	1460.849	2+						
		4580 1 & 5		0	0^{+}	[F3]		E.: observed only in 40 Cl β^- decay			
4602		2078	100.2	2524 09	2+	[13]		Ly. observed only in Crp deedy.			
1002		3141	11 2	1460 849	$\frac{2}{2^{+}}$						
4674	$(1^+ 2^- 3^+)$	3213	100	1460 849	$\frac{2}{2^{+}}$						
1071	(1,2,5)	1737 5 <mark>&</mark> 1	100	0	2 0+						
4757.81	1-	4757.5 4	100	0	0+						
4709.0	1 4 ⁺	4708.7 5	100 10	2802.65	0 4 ⁺	M1 + E2		Mult δ : based on $\alpha(\theta$ pol) in $(\alpha, p\alpha)$ with $\delta(E2/M1) = 0.22 \pm 13$. 5 or			
4/94	+	1901	100 10	2892.05	+	IVII +1.2		+1.60 15.			
10.50	-	3333	100 10	1460.849	2+	[E2]		B(E2)(W.u.) = 1.65			
4858	5-	364	15 8	4494	5-						
		1394	36.2	3464.56	6+	[E1]	0.00 0.10	B(E1)(W.u.) = 0.0014 4			
		1965	100 3	2892.65	4+	E1(+M2)	-0.09 + 8 - 12	B(E1)(W.u.)=0.0014 4			
		0						Mult., δ : based on $\gamma(\theta, \text{pol})$ in $(\alpha, p\gamma)$.			
4901?		4901 X 3		0	0^{+}						
4929	$(1^{-} \text{ to } 4^{+})$	1248	100 8	3680.60	3-						
		2405	44 6	2524.09	2^{+}						
		3468	56 6	1460.849	2+						
4942.6?		361.3 ^{&} 5	90 20	4578	3(-)						
		381.0 % 5	100 40	4562.36	$(1 3)^{-}$						
4959	6+	1444	100 5	3515	(1,5) 4 ⁺	F2		$B(F2)(W_{H}) - 7 \times 10^{1}$ 3			
7232	0	1 444	100 5	5515	7	122		Mult : based on $\gamma(\theta)$ in $(\alpha p \gamma)$: RUL rules out M2			
								man. Suber on f(0) in (a,p)), not futes out 102.			

 $^{40}_{18}\mathrm{Ar}_{22}$ -12

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Adopted Levels, Gammas (continued) $\gamma(^{40}\text{Ar})$ (continued) Mult.@ E_{γ}^{\dagger} $I_{\gamma}^{\#}$ J_i^{π} \mathbf{E}_{f} Comments 6^{+} 2066 56 5 2892.65 4^{+} E2 B(E2)(W.u.)=7.3Mult.: based on $\gamma(\theta)$ in $(\alpha, p\gamma)$; RUL rules out M2. $(2^+, 3, 4^+)$ 2079 100 7 2892.65 4+ 3511 697 1460.849 2+ 4(-) 4230 4(-) 761 100 2 (M1+E2) Mult., δ : from $\gamma(\theta, \text{pol})$ in $(\alpha, p\gamma)$, with $\delta(O/D) = -0.13$ to +0.77 or -0.72 to -1.5. 909 4082.63 3-11 *I* 10 *I* 3680.60 3-1310 5110[&] 3 0 0^{+} 3464.56 6+ (5^{-}) 1651 100 (5) 1628 20 2 3515 4^{+} 1678 100 2 3464.56 6+ $(2)^{+}$ 1650 100 4 3515 4^+ E_{γ} , I_{γ} : observed in $(\alpha, p\gamma)$ only. This strong transition is not seen in ⁴⁰Cl β^{-} decay. It could suggest that it may be misplaced. I_{γ} : from $(\alpha, p\gamma)$. Other: 100 10 from ⁴⁰Cl β^- decay. 3704.68 43 4 1460.849 2+ 5165.5[&] 10 E_{γ} : observed in ⁴⁰Cl β^- decay only. 42 0 0^+ I_{γ} : normalized to I(3704.6 γ)=43 4 from (α ,p γ) by the factor of $I(5165.5\gamma)/I(3704.6\gamma)=10 5/100 10 \text{ from } {}^{40}\text{Cl} \beta^{-} \text{ decay.}$ $(0^+ \text{ to } 4^+)$ 3784 100 1460.849 2+ $(1^{-},3^{-})$ 1186.7 4 758 4082.63 3-1589.0 3 3680.60 3-100 17 3207.93 2+ 2063.0 10 42 17 (2^{+}) 3832 100 1460.849 2+ (2^+) 748 23 2 4562.36 (1,3)-1228 85 6 4082.63 3-1629 100 6 3680.60 3-5309.6[&] 10 0 0^+ E_{γ} : only transition observed from a level at 5310 in ⁴⁰Cl β^{-} decay, not observed in other studies. The evaluator has considered this transition as questionable. 2457 100 2892.65 4^{+} $(4^+, 5, 6^+)$ 42 4 3515 4^{+} 1863 6+ 1913 55 4 3464.56 2892.65 4^{+} 2485 100 8 1^{-} 0^{+} 5400.1 8 100 0

 E_i (level)

4959

4972

4991

5110?

5115

5143

13

5165.6

5245 5269.6

5293

5310

5350

5378

5400.5

5508

5544

5559

5608.8

5611

5630

NATURAL

 $(0^+ \text{ to } 4^+)$

 $(4^+, 5^-, 6^+)$

(1,2,3)

1993

4083

2044

2094

2666

2147

1203

4147.7 10

3515

3515 3464.56 6+

4427

2892.65

1460.849 2+

1460.849 2+

3464.56 6+

100

100

46 4

61 4

100 7

100

100

100

 4^{+}

 4^{+}

4+

 (4^{+})

$\gamma(^{40}\text{Ar})$ (continued)

Comments

 E_{γ} : only transition observed from a level at 5630 in 40 Cl β^- decay, not observed in other studies. The evaluator has considered this transition as questionable.

E _i (level)	\mathbf{J}_i^π	E_{γ}^{\dagger}	$I_{\gamma}^{\#}$	E_f	\mathbf{J}_f^{π}
5630		5629.0 ^{&} 10		0	0+
5654		3130	100	2524.09	2+
5662		2769	100	2892.65	4+
5675	$(3^{-},4^{+})$	1994	100	3680.60	3-
5717.8?		3193.7 <mark>&</mark> 10	100	2524.09	2^{+}
5766		2558	100	3207.93	2^{+}
5818	$(3^{-},4^{+})$	2925	100	2892.65	4^{+}
5880.3	1-	1317.2 5	10 <i>I</i>	4562.36	$(1,3)^{-}$
		1579.9 8	82	4301.08	$(3)^{-}$
		3356.6 8	8 <i>3</i>	2524.09	2+
		3759.9 10	2.6 13	2120.91	0^{+}
		5879.6 12	100 5	0	0^{+}
5885	3-	2992	100 7	2892.65	4+
		4424	87 7	1460.849	2+
5906.0	(1^{-})	3784.9 6	100	2120.91	0^{+}
5912	1	5912 <i>3</i>	100	0	0^{+}
5912	$(1^{-} \text{ to } 4^{+})$	1830	100 10	4082.63	3-
		2704	100 10	3207.93	2^{+}
5931	$(2^+, 3, 4^+)$	3038	100 6	2892.65	4+
		4470	39 6	1460.849	2^{+}
5950.5	(1,2)	5950.0 10	100	0	0^{+}
5973	(6 ⁻)	2508	100	3464.56	6+
6013	(7-)	1519	100 6	4494	5-
		2548	100 6	3464.56	6+
6053.6	$1^{(-)}$	6053.1 8	100	0	0^{+}
6100	$(1,2^+)$	4638 <i>3</i>	100 7	1460.849	2^{+}
		6100	33 7	0	0^{+}
6104		3211	100	2892.65	4+
6138		2674	100	3464.56	6+
6158	$(4^+, 5, 6^+)$	2693	100 2	3464.56	6^{+}
		3265	15 2	2892.65	4+
6185		1691	100	4494	5-
6203		3310	100	2892.65	4+
6208.5	(1,2)	6208.0 8	100	0	0^{+}
6270		2805	100	3464.56	6+
6276.0?	1-,2-,3-	1333.4 <mark>&</mark> 8	100	4942.6?	
6305	$(4^+, 5, 6^+)$	2790	100 8	3515	4+
		2840	67 8	3464.56	6+
6338.7	1-	6338.2 11	100	0	0^{+}
6356	(4 ⁺ to 7 ⁻)	1498	100 8	4858	5-

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E_{γ} : 1522 from ²⁶ Mg(¹⁸ O,2p2nγ). E_{γ} : 2553 from ²⁶ Mg(¹⁸ O,2p2nγ).	
E_{γ} : from (γ, γ') .	

 $^{40}_{18}\mathrm{Ar}_{22}$ -14

						Adopted	Levels, Gammas (continued)
							40 + > < - + - >
						÷	γ (**Ar) (continued)
E _i (level)	\mathbf{J}_i^{π}	E_{γ}^{\dagger}	$I_{\gamma}^{\#}$	E_f	\mathbf{J}_{f}^{π}	Mult. [@]	Comments
6356	$(4^+ \text{ to } 7^-)$	2891	49.8	3464.56	6+		
6421	(8^{-})	2956 [‡]	., .	3464 56	6 ⁺		
64502	(0)	$6450^{\&}$ 3		0	0+		
6476.0	1-	6475.5 8	100	0	0^{+}		
6651.7		1042.3 & 3	100	5608.8	(1.2.3)		
6703	1	6703 3	100	0	0^+		
6806	(8 ⁺)	1847	100	4959	6+		E_{γ} : from $(\alpha, p\gamma)$. Other: 1841 from $({}^{18}O, 2p2n\gamma)$.
6979	(8 ⁻)	1006	100	5973	(6 ⁻)		
7168	1	7168 <i>3</i>	100	0	0^{+}		
7246	1	7246 3	100	0	0^{+}		
7281	1	7281 3	100	0	0^+		
7519	1	/519 3	100	0	0.		
7626	1	6168 ⁴ 3	100	1460.849	2+ 0+		
5.00		/020 3	100	0	0.		
7688	(9 ⁻)	/09+		6979	(8 ⁻)		
	4-	1671+	100	6013	(7-)	-	
7708	1-	7/08 3	100	0	0^+	El E1	
7918	1 1 ⁻	7918 2	100	0	0^{+}	EI E1	
7993	(10^{-})	211	100	7699	(0^{-})	LI	
/999	(10)	311		/088	(9)		
		1020*		6979	(8)		
		1578+		6421	(8 ⁻)		
8032	1-	6570 ^{x} 3	100	1460.849	2+	-	
		8032 3	100	0	0	EI	
8163	1-	6703 ^{C} 2	100	1460.849	2^+	F 1	
Q101	1-	8103 2	100	0	0^{+}	EI E1	
8303	1 1 ⁻	8303 3	100	0	0^{+}	EI F1	
8552	1-	8552 3	100	0	0^{+}	E1	
8585	1-	8585 3	100	0	0^{+}	E1	
8644	1-	8644 <i>3</i>	100	0	0^{+}	E1	
8676	$1,2^{+}$	8676 <i>3</i>	100	0	0^{+}		
8834	1-	8834 4	100	0	0^+		
8884	1-	8884 3	100	0	0^+	EL	$D(E_1)(W_{12}) = 0.0006/2$
8918	1	891/3	100	0	0'	EI	B(E1)(W.U.)=0.00063
8946	(11 ⁻)	947+		/999	(10^{-})		
		1258+		7688	(9-)		
9070	(10^{+})	2269‡		6806	(8+)		

From ENSDF

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$\gamma(^{40}\text{Ar})$ (continued)

E _i (level)	J_i^π	E_{γ}^{\dagger}	$I_{\gamma}^{\#}$	E_f	J_f^{π}	Mult. [@]	Comments
9127	1-	9128.3	100	0	0^{+}	E1	B(E1)(Wu) = 0.00118.24
9314	1-	9313	100	Ő	0^+	21	
9337	1-	9337 3	100	Ő	0^+		
9355	1-	5054	7	4301.08	$(3)^{-}$		
		5436	8	3918.85	2+		
		9356 3	100	0	0^{+}	E1	
9416	1-	5333	54	4082.63	3-		
		5497	40	3918.85	2+		
		5904	51	3511.54	2^{+}		
		6891	9	2524.09	2^{+}		
		7954	31	1460.849	2^{+}		
		9416 <i>3</i>	100	0	0^{+}	E1	
9450	1-	5938	23	3511.54	2+		
		6242	23	3207.93	2^{+}		
		6557	11	2892.65	4+	[E3]	
		6925	37	2524.09	2^{+}		
		7328	34	2120.91	0^{+}		
		7988	100	1460.849	2^{+}		
		9449	69	0	0^{+}		
9504.2	1-	5585	3	3918.85	2^{+}		
		7383	2	2120.91	0^{+}		
		8043	7	1460.849	2+		
		9503	100	0	0^{+}	E1	
9583	1-	5664	12	3918.85	2+		
		6690	12	2892.65	4+	[E3]	
		7058	27	2524.09	2^{+}		
		7461	61	2120.91	0^{+}		
		8121	44	1460.849	2+		
		9582 <i>3</i>	100	0	0+	(E1)	
9617	1-	5698	11	3918.85	2+		
		5936	4	3680.60	3-		
		6105	4	3511.54	2+		
		6409	9	3207.93	2	[[]]]	
		6/24	15	2892.65	4' 2+	[E3]	
		7092	15	2524.09	2		
		/495	/	2120.91	0^{+}		
		8133	100	1460.849	2 · 0+		
0600	$(1 - 2^{+})$	9010 5099	0/	4602	0.		
9090	(1,2)	JU88 5365	20	4002	2+		
		5771	13	4324.3 3018 85	$\frac{2}{2^+}$		
		6178	11	3511.03	$\frac{2}{2^{+}}$		
		0170	11	5511.54	2		

						Adopte	d Levels, Gammas (continued)	
							γ ⁽⁴⁰ Ar) (continued)	
E_i (level)	\mathbf{J}_i^π	E_{γ}^{\dagger}	$I_{\gamma}^{\#}$	E_{f}	\mathbf{J}_{f}^{π}	Mult. [@]		Comments
9690	$(1^{-},2^{+})$	6482	9	3207.93	2+			
		7165	100	2524.09	2+			
		8228	7	1460.849	2^+			
0736	1-	9089 5134	10	0 4602	01			
9750	1	5817	27	3918 85	2+			
		6528	23	3207.93	$\frac{2}{2^{+}}$			
		7211	10	2524.09	2+			
		7614	15	2120.91	0^{+}			
		8274	23	1460.849	2+			
0757	1+	9735	100	0	0^+	1.61		
9/5/	1' 1-	9/5/3 5006	100	0	0^{+} 2+	MI	B(M1)(W.u.)=0.029 12	
9823	1	6144	36	3680.60	2 3 ⁻			
		6313	8	3511.54	2^{+}			
		6617	52	3207.93	2+			
		7300	68	2524.09	2+			
		7703	28	2120.91	0^+			
		8363	100	1460.849	2^+			
0840	1-	9824	08 100	0	0^{+}			
9040	1	9040 J	100	2802.65	0	[[]2]		
9851	1	7326	19 60	2892.03	4 · 2+	[E3]		
		8389	53	1460.849	2^{+}			
		9850 2	100	0	$\frac{1}{0^{+}}$	E1		
9944	1-	6025	13	3918.85	2+			
		7419	61	2524.09	2+			
		7822	24	2120.91	0^+			
		8482	66	1460.849	2 ⁺			
0052	1-	9945 5627	100	1324 5	0^{+}			
<i>JJJL</i>	1	5910	3	4042	NATURAL			
		6033	3	3918.85	2+			
		7427	13	2524.09	2+			
		8490	17	1460.849	2+			
10000	1 -	9950 <i>3</i>	100	0	0^+	El		
10090	1 1-	10090 3	100	0	0' 0+	EI E1		
10131	1 1-	10151 5	100	0	0+	E1		
10362	1.2+	10362.3	100	0	$\tilde{0}^+$	1.1		
10745	1-	10745 3	100	Õ	0+	E1		

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$^{40}_{18}\mathrm{Ar}_{22}$ -17

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$\gamma(^{40}\text{Ar})$ (continued)

E_i (level)	\mathbf{J}_i^{π}	E_{γ}^{\dagger}	$I_{\gamma}^{\#}$	E_f	\mathbf{J}_{f}^{π}	Mult. [@]
10857	1-	10857 <i>3</i>	100	0	0^{+}	E1
11769	(12^{+})	2699 [‡]		9070	(10^{+})	

[†] Values with uncertainties are from ⁴⁰Cl β^- decay if available, otherwise from (γ,γ'), and those without uncertainties are for transitions reported in ($\alpha,p\gamma$) up to 6979 level ($\Delta E\gamma$ =1-2 keV) and in (α,γ):resonances after 8919 level ($\Delta E\gamma$ =3-5 keV) and are taken from level-energy differences by evaluator, unless otherwise noted.

[‡] Observed in ${}^{26}Mg({}^{18}O,2p2n\gamma)$ only.

[#] From ⁴⁰Cl β^- decay if available, otherwise from (α ,p γ) up to 6979 level and from (α , γ):resonances after 8919 level, unless otherwise noted.

^(a) From $(\alpha, p\gamma)$ based on measured $\gamma(\theta)$ and $\gamma(\ln pol)$ up to 6979 level, and from (γ, γ') based on polarization asymmetry after that, unless otherwise noted. [&] Placement of transition in the level scheme is uncertain.

From ENSDF

Legend

Level Scheme
Intensities: Relative photon branching from each level

 $--- \rightarrow \gamma$ Decay (Uncertain)



Level Scheme (continued)

Intensities: Relative photon branching from each level





Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

 $--- \rightarrow \gamma$ Decay (Uncertain)



Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

 $--- \rightarrow \gamma$ Decay (Uncertain)



Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

 $--- \rightarrow \gamma$ Decay (Uncertain)



Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

--- γ Decay (Uncertain)



Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

 $--- \rightarrow \gamma$ Decay (Uncertain)



 $^{40}_{18}{
m Ar}_{22}$

 $^{40}_{18}\mathrm{Ar}_{22}\text{--}26$

Adopted Levels, Gammas

Legend

Level Scheme (continued)







 $^{40}_{18}{
m Ar}_{22}$