^{40}Ca(^{3}He,pγ) 1971Ro30,2007Sc26

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen[#] and Balraj Singh	NDS 135, 1 (2016)	31-May-2016

1971Ro30: E=8.4, 8.6 MeV ^{3}He beam from the Utrecht MV tandem Van de Graaff accelerator. Targets of natural calcium metal on carbon foils. Protons were detected with two 1.5 mm Si surface-barrier detectors and γ-rays were detected with a Ge(Li) detector at 90′. Measured Eγ, Iγ, pγ-coin. Deduced levels, branching ratios, lifetimes by Doppler Shift Attenuation Method (DSAM).

2007Sc26: E=9 MeV beam from FN Tandem accelerator at Cologne university. Natural calcium target. Measured Eγ, Iγ, $\gamma\gamma$, $\gamma\gamma(\theta)$ using HORUS array comprised of nine HPGe detectors and a Euroball cluster detector. Two HPGe detectors were at 45° to the beam axis, and two at 135°. The cluster Ge detector and five HPGe detectors were in a plane perpendicular to the beam axis.

Others:

2004Or03: E=4.2, 5.1 MeV. Measured Eγ, Iγ, DSA.

1973Ha10: E=10.0-11.5 MeV. Targets of natural calcium on Ta backings. Protons were detected in annular silicon surface-barrier detectors and γ-rays in a Ge(Li) detector (FWHM=10 keV at 1.33 MeV). Measured Eγ, pγ-coin. Deduced levels, lifetimes by DSAM.

1969Ni03: E=8.0-9.0 MeV ^{3}He beam from the University of Liverpool tandem accelerator. Natural calcium targets. Proton counter, Ge(Li) and NaI(Tl) detectors. Measured Eγ, Iγ, $\gamma(\theta)$, $\gamma\gamma$-coin, pγ-coin. Deduced levels, branching ratios, mixing ratios and lifetimes by DSAM.

1974Br04: E=10.5 MeV ^{3}He beam from the Stony Brook tandem Van de Graaff accelerator. Target of a 50 μg/cm^{2} natural Ca on a Au backing. Ge(Li) detector. Measured Eγ, Iγ. Deduced levels, $T_{1/2}$ using Recoil Distance Method (RDM) for levels at 1490 and 1511 keV.

1970Fa09: E=10 MeV. Measured Eγ, p$\gamma(\theta)$.

1970Ba26 (also 1970AnZZ): E=10, 15 MeV. Measured Eγ, p$\gamma(\theta)$. Deduced levels, J^{π}, branching ratios, mixing ratios.

1966Zu01: E=10, 12, 15 MeV. Measured pγ-coin $\gamma(\theta)$.

Additional information 1.

^{42}Sc Levels

E(level)[†]	J$^{\pi}$[‡]	$T_{1/2}$[@]	Comments
0	0^{+}		T=1
611.21 *20*	1^{+}[#]	28 fs *12*	T=0 $T_{1/2}$: other: 97 fs *28* (1973Ha10).
617.7 *18*	7		T=0 J$^{\pi}$: from p$\gamma(\theta)$ (2007Sc26).
1490.8 *5*	3^{+}	30 ps *+17−6*	T=0 $T_{1/2}$: from RDM (1974Br04).
1511.5 *18*	5	43 ps *8*	T=0 $T_{1/2}$: from RDM (1974Br04).
1586.4 *4*	2^{+}[#]	54 fs *12*	T=1 $T_{1/2}$: weighted average of 69 fs *21* (1971Ro30), 62 fs *31* (1973Ha10), 48 fs *12* (2004Or03).
1846.4 *21*	3$^{(+)}$	<3.5 ns	T=0 $T_{1/2}$: 0.7 ps to 3.5 ns.
1873.9 *7*	0^{+}	<70 fs	T=1 J$^{\pi}$: from isotropic $\gamma(\theta)$.
1888.9 *8*	1$^{(+)}$	<42 fs	T=0 $T_{1/2}$: other: 42 fs *21* (1973Ha10). J$^{\pi}$: spin=1 from p$\gamma(\theta)$ (1970Ba26,1970Fa09).
2188.0 *6*	3$^{(+)}$	0.54 ps *24*	T=0
2222.6 *6*	(1)	87 fs *35*	E(level): doublet, since $T_{1/2}$ values are different for 636γ and 2223γ. $T_{1/2}$: from DSA measurement on 2223γ. $T_{1/2}$=0.63 ps *35* from DSA on 636γ.
2270.0 *7*	2		T=0
2296.5 *21*	(1^{+},2^{+})		T=0
2433.4 *15*	4$^{(+)}$		T=0

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^{40}Ca(^{3}He,pγ) 1971Ro30,2007Sc26 (continued)

^{42}Sc Levels (continued)

E(level)[†]	J$^{\pi}$[‡]	T$_{1/2}$[@]	Comments
2455.1 *20*		0.18 ps *11*	
2488.4 *10*	2	<50 fs	T=1
2535.1 *20*		0.66 ps *28*	
2586.9 *17*	(2^{+},4^{+})		T=0
2650.5 *12*			
2817.0 *16*	4	<70 fs	T=1
2833.2? *11*		0.21 ps *11*	
2847.8 *12*		0.20 ps *12*	
2910.2 *14*	(2^{+},4^{+})	>0.83 ps	T=0
3023.4 *19*	4		T=0
3090.2 *21*		0.21 ps *4*	
3392.9 *11*	3	62 fs *49*	T=0
3687.8 *8*	1	<28 fs	T=0
3933.6 *14*	3$^{(+)}$	<52 fs	T=0

[†] From least-squares fit to Eγ data.
[‡] From $\gamma\gamma(\theta)$ in 2007Sc26, unless otherwise noted.
[#] Spin from p$\gamma(\theta)$ (1970Ba26) and $\gamma\gamma(\theta)$ (2007Sc26), parity from comparison of experimental population ratios with theory (1970Ba26).
[@] From DSAM (1971Ro30), unless otherwise stated.

γ(^{42}Sc)

Detailed $\gamma\gamma(\theta)$ plots are shown by 2007Sc26 for the following cascades with best fits indicated for spin-sequence and mixing ratios of both transitions in a cascade: 601-975, 709-975, 880-611, 905-1875, 923-894, 943-880, 975-611, 996-880, 1096-880, 1235-611, 1305-894, 1325-880, 1420-880, 1513-894, 1658-611, 1875-611, 2101-975, 2347-975.

A transition from 1880 doublet (composite of 1874 and 1889 levels here) to 1586 level (shown by 1969Ni03 and 1970Ba26) has been omitted here since it is not confirmed in any other study.

A_2 and A_4 are from 1969Ni03 using NaI(Tl) detector.

E$_i$(level)	J$_i^{\pi}$	E$_{\gamma}$[†]	I$_{\gamma}$[†]	E$_f$	J$_f^{\pi}$	Mult.[&]	δ[&]	Comments
611.21	1^{+}	611.2 *2*	100	0	0^{+}	(M1)		A_2=−0.48 *1*; A_4=−0.03 *1* E$_{\gamma}$: weighted average of 611.5 *5* from 1969Ni03 and 611.2 *2* from 1973Ha10. Mult.: dipole from $\gamma(\theta)$ (1969Ni03) and $\gamma\gamma(\theta)$ (2007Sc26); $\Delta\pi$ requires M1.
1490.8	3^{+}	879.6 *4*	100	611.21	1^{+}	E2		A_2=+0.22 *4*; A_4=−0.19 *4* (1969Ni03) E$_{\gamma}$: weighted average from 1971Ro30, 1973Ha10 and 1969Ni03. Mult.: from $\gamma(\theta)$ (1969Ni03) and RUL. δ: δ(O/Q)=−0.01 *3* (2007Sc26), −0.07 *24* (1970Ba26), +0.39 *7* or +0.25 *7* (1969Ni03).
1511.5	5	893.8 *4*	100	617.7	7	(E2(+M3))	−0.07 *5*	Mult.: $\gamma\gamma(\theta)$ (2007Sc26) and RUL. δ: or −0.16 *12*. E$_{\gamma}$: weighted average from 1971Ro30, 1973Ha10 and 1969Ni03.
1586.4	2^{+}	975.2 *4*	91[@] *6*	611.21	1^{+}	(M1+E2)	+0.05 *3*	E$_{\gamma}$: weighted average from 1971Ro30, 1973Ha10 and 1969Ni03.

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^{40}Ca(^{3}He,pγ) 1971Ro30,2007Sc26 (continued)

$\gamma(^{42}Sc)$ (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[&]	δ[&]	Comments
								Additional information 2. Mult.,δ: from 1970Ba26. Other: δ=0.000 *21* (2007Sc26).
1586.4	2^+	1586.1 *11*	9[@] *2*	0	0^+			
1846.4	$3^{(+)}$	260 *2*	100	1586.4	2^+			
		1235[‡]		611.21	1^+	(Q(+O))	−0.12 *15*	Mult.: $\gamma\gamma(\theta)$ (2007Sc26).
1873.9	0^+	1262.5 *7*	100	611.21	1^+	D		A_2=+0.03 *3*; A_4=+0.04 *3* (1969Ni03)
1888.9	$1^{(+)}$	1888.9 *8*	100	0	0^+	(M1)		A_2=+0.20 *3*; A_4=+0.08 *4* (1969Ni03)
								E_γ: weighted average from 1971Ro30 and 1973Ha10. Additional information 3.
2188.0	$3^{(+)}$	601.6 *4*	100	1586.4	2^+	(M1+E2)	−0.23 *4*	E_γ: weighted average from 1971Ro30 and 1973Ha10. Additional information 4.
		1576[‡]		611.21	1^+			
2222.6	(1)	636.2 *5*	50	1586.4	2^+			E_γ: weighted average from 1971Ro30 and 1969Ni03. Additional information 5.
		2222.6 *13*	50	0	0^+			A_2=0.00 *5*; A_4=+0.08 *7* (1969Ni03)
2270.0	2	683.5 *5*	24[#]	1586.4	2^+			
		1661 *3*	76[#]	611.21	1^+	D(+Q)	−0.06 *6*	
2296.5	$(1^+,2^+)$	710 *2*		1586.4	2^+	(M1+E2)	−2.7 *8*	
2433.4	$4^{(+)}$	923[‡]		1511.5	5	(M1+E2)	+0.40 *9*	
		943[‡]		1490.8	3^+	(M1+E2)	−0.48 *11*	
2455.1		2455[a] *2*		0	0^+			
2488.4	2	996[‡]		1490.8	3^+	D(+Q)	−0.02 *4*	
		1877.1 *9*	100	611.21	1^+			
2535.1		2535[a] *2*		0	0^+			
2586.9	$(2^+,4^+)$	1095.7 *16*		1490.8	3^+	(M1+E2)	−0.10 *6*	
2650.5		1064.0[a] *11*		1586.4	2^+			
2817.0	4	969[‡]		1846.4	$3^{(+)}$	D		
		1305.4 *7*	100	1511.5	5	D+Q	−0.06 *4*	
		1325[‡]		1490.8	3^+	D(+Q)	0.00 *4*	
2833.2?		1246.6[a] *9*		1586.4	2^+			
2847.8		1261.2[a] *11*		1586.4	2^+			
2910.2	$(2^+,4^+)$	1419.0 *12*		1490.8	3^+	(M1+E2)	−0.14 *7*	
3023.4	4	1513[‡]		1511.5	5	D(+Q)	−0.03 *8*	
3090.2		2472.4 *10*	100	617.7	7			
3392.9	3	575.9 *12*		2817.0	4			
		904.5 *5*	100	2488.4	2	(M1+E2)	−0.11 *5*	
3687.8	1	1813.5 *11*	15	1873.9	0^+			
		2101.2 *10*	75	1586.4	2^+	D+Q	−0.07 *4*	
		3689 *2*	10	0	0^+			
3933.6	$3^{(+)}$	2347.1 *13*		1586.4	2^+	(M1+E2)	1.2 *5*	

[†] From 1971Ro30, unless otherwise noted.
[‡] From 2007Sc26 only.
[#] From 1969Ni03.
[@] From 1970Ba26.

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^{40}Ca(^{3}He,pγ) 1971Ro30,2007Sc26 (continued)

$\gamma(^{42}Sc)$ (continued)

& From 2007Sc26, unless otherwise noted.
[a] Placement of transition in the level scheme is uncertain.

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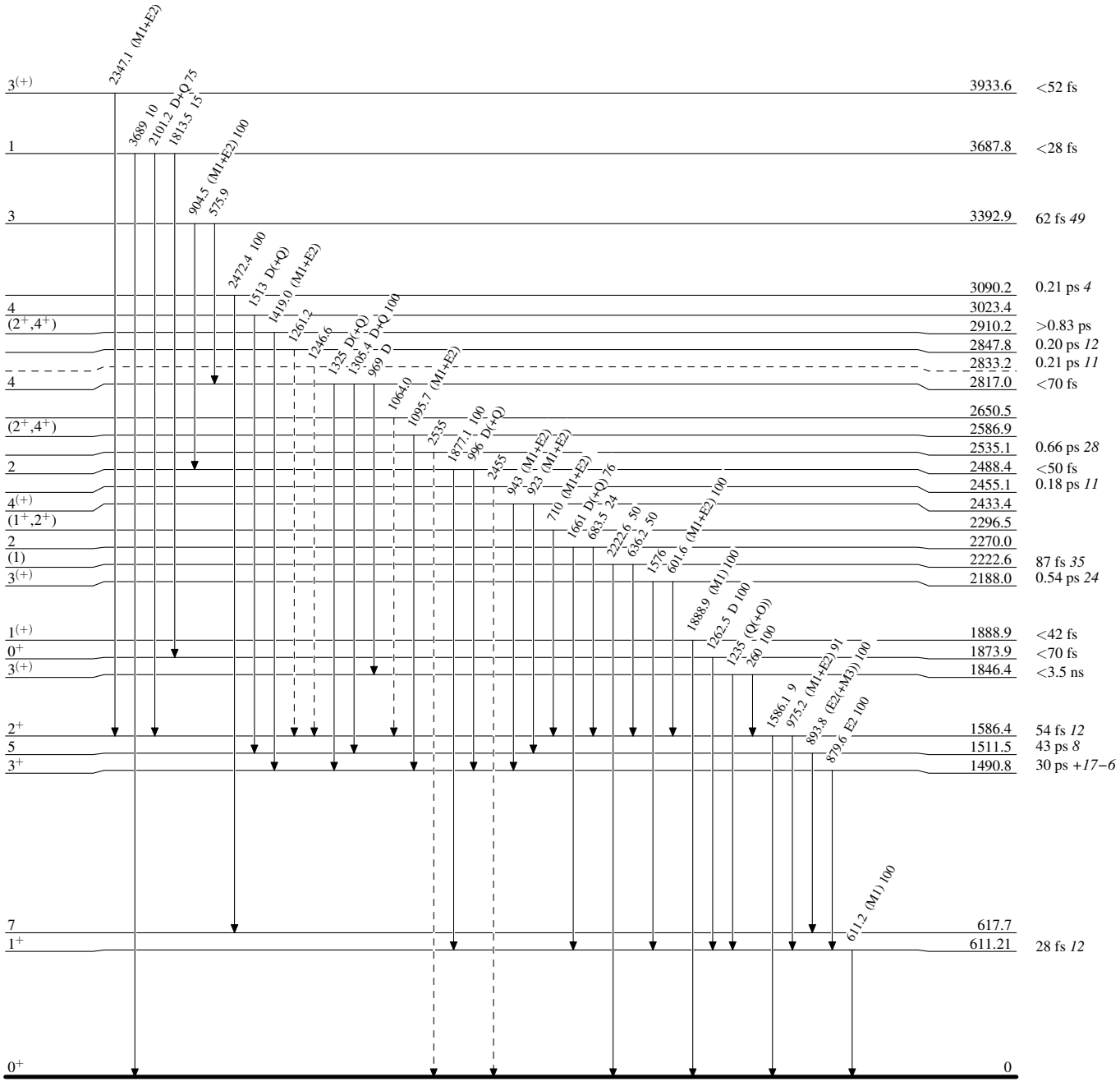
Legend

Level Scheme

Intensities: % photon branching from each level

- - - - - - ► γ Decay (Uncertain)



$^{42}_{21}Sc_{21}$