^{40}Ca(d,α),(pol d,α) 1975Co09,1976Pe11,1983Bh05

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 152, 1 (2018)	30-Sep-2017

1975Co09: (d,α) E=7.84-16.0 MeV deuteron beams were produced from the University of Notre Dame FN tandem Van de Graaff accelerator. Targets were natural Ca metal (97% in ^{40}Ca) on carbon backings. Reaction products were momentum-analyzed with a broad-range magnetic spectrograph and detected with nuclear track plates. Measured Eα. Deduced levels. Reported 79 levels up to 6022 keV. 1975Co09 also report data on ^{40}Ca(d,$\alpha\gamma$) and ^{36}Ar(^{3}He,pγ).

1976Pe11 (also thesis by 1977PeYX): (pol d,α) E=7.5,7.75,8.0 MeV polarized deuteron beams were produced from the McMaster Lamb-shift polarized ion source and accelerated by the FN tandem accelerator. Target was a 25 μg/cm^2 natural Ca on a carbon backing. Reaction products were momentum-analyzed with an Engel split-pole magnetic spectrograph and detected with a position-sensitive gas proportional counter. Measured Ay(Eα,θ). Deduced levels, natural and unnatural parity. Report 24 levels up to 4214 keV.

1983Bh05: (d,α) E=22.8 MeV deuteron beam was produced from the Argonne National Laboratory cyclotron. Target was enriched ^{40}Ca on a thin carbon backing. Reaction products were detected with four ΔE-E counter telescopes (FWHM=135 keV). Measured σ(Eα,θ). Deduced levels, J, π, L-transfers from DWBA analysis. Energy uncertainties: 30 keV below 4 MeV and 50 keV above this energy. About 20 groups reported up to 10260 keV. Cross sections listed for ten groups.

Others:

1988Me11 (also 1987Me01): (pol d,α) E=20 MeV; measured Ay(Eα,θ), Q3D magnetic spectrograph, DWBA analysis for g.s., 459, 1697 and 3431 states.

1985AoZY: (pol d,α) E=22 MeV; measured Ay(θ) for g.s., 459 and 1698 level, confirming 3^+, 1^+ and 1^+, respectively.

1977StZB (thesis): (d,α) E=16.3 MeV. Measured $\sigma(\theta)$ from 7.5° to 70°. Scattered particles detected by a helical-cathode proportional chamber in the focal plane of the spectrometer. Ten α groups observed up to 3 MeV excitation energy.

1978Lu03: (pol d,α) E=16.5 MeV; measured σ(Eα,θ), Ay(Eα,θ), DWBA analysis for 459, 1^+ state.

1976Ri05: (pol d,α) E=5.9-6.8 MeV; measured σ(180°) with a tensor polarized deuteron beam, measured <T_{20}>for g.s., 459, 1698, 2403 and 2992 levels, deduced 0^- for 2992 level.

1974Fr10: (d,α) E=80.2 MeV; measured σ(Eα,θ), DWBA analysis, magnetic spectrometer, FWHM=160-200 keV. Seventeen groups reported up to 7350 keV.

1974Sm02: (d,α) E=4.00-4.61 MeV; measured σ(Eα,θ), solid-state detectors. Eight groups reported up to about 3000 keV.

1971De17: (d,α) E<5.5 MeV; measured σ(E).

1971Su05: (d,α) E=11.4 MeV; measured σ(Eα,θ), DWBA analysis, ten groups reported up to 3970, cross sections listed.

1971Kr03: (d,α) E=5-10 MeV; measured σ(Eα,θ), seven groups reported up to 2830 keV.

1969Te07, 1969De29: (d,α) E=7 MeV; measured σ(Eα,θ), semiconductor detector, FWHM=40 keV. Four groups reported up to 2400 keV.

1967He16: (d,α) E=9.20 MeV; measured σ(Eα,θ), magnetic spectrograph, five groups reported up to 2406 keV.

1965Is04: (d,α) E=15.14 MeV; measured σ(Eα,θ), magnetic spectrograph, nine groups reported up to 3850 keV.

1965Mi04: (d,α) E=14.8 MeV; measured σ(Eα,θ) using a semiconductor detector. Ten groups observed up to about 4300 keV.

1963Ja14: (d,α) E=7.7 MeV; measured σ(Eα,θ) using a magnetic analyzer, FWHM≈25 keV. A total of 40 groups reported up to 4780 keV, energy uncertainty=20 keV.

1963Ta06: (d,α) E=5.46 MeV. Measured σ(Eα,θ) at 30°, 50°, 70° and 90° with a magnetic spectrograph, 12 α groups observed up to 3980 keV with typical uncertainty of ≈10 keV. Differential cross sections are listed which vary from 0.08 to 0.65 mb/sr.

1959Ha17: (d,α) E=3.3-4.1 MeV. Measured $\sigma(\theta)$ for g.s. and 130 level.

^{38}K Levels

E(level)[†]	J$^\pi$	L[e]	Comments
0	3^+[#a]	4+2	L: 4 (1978Lu03,1977StZB,1971Su05), 4(+2) (1974Fr10).
131 *2*	0^+[b]		E(level): from 1977StZB. Others: 1963Ja14, 1965Is04, 1967He16, 1971Kr03 and 1974Sm02. J$^\pi$: from Adopted Levels.
459.0 *8*	1^+[#a]	0+2	E(level): other: 461 *2* (1977StZB). L: 2 (1971Su05,1977StZB).
1697.5 *12*	1^+[#&ad]	0+2	L: 0+2 (1974Fr10), 2 (1971Su05,1977StZB).

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^{40}Ca(d,α),(pol d,α) 1975Co09,1976Pe11,1983Bh05 (continued)

^{38}K Levels (continued)

E(level)[†]	Jπ	L[e]	Comments
			E(level): other: 1700 *2* (1977StZB). <T$_{20}$>=+0.47 *7* (1976Pe11).
2402.4 *15*	2$^+$@*bd*		E(level): other: 2405 *2* (1977StZB). <T$_{20}$>=+0.69 *9* (1976Pe11).
2613.7 *13*	3$^-$@*c*		E(level): other: 2612 *2* (1977StZB). L: (3) (1977StZB). <T$_{20}$>=+0.71 *9* (1976Pe11).
2646.5 *13*	4$^-$,2$^-$&	1+3,3	Jπ: (2,4)$^-$ (1976Pe11); L=1+3 (1983Bh05) gives 2$^-$ but with FWHM=135 keV, the 2646 peak in this work is not resolved from 2613, 3$^-$ level; also L=3 in 1971Su05 and L=(3) in 1977StZB. E(level): other: 2647 *2* (1977StZB). <T$_{20}$>=−1.05 *13* (1976Pe11).
2827.5 *15*	1$^-$@*d*		E(level): other: 2831 *4*. L: (3) (1977StZB). <T$_{20}$>=+0.52 *20* (1976Pe11).
2869.9 *15*	2$^-$&*c*	1+3	E(level): other: 2869 *2* (1977StZB). L: (3) (1971Su05,1977StZB). <T$_{20}$>=−0.58 *11* (1976Pe11).
2991.9 *16*	0$^-$&*d*		E(level): other: 2994 *4* (1977StZB). Jπ: from <T$_{20}$>(180°)=−1.08 *9* (5.9 MeV), −0.98 *5* (6.1 MeV), −1.03 *3* (6.4 MeV), −1.00 *5* (6.6 MeV) (1976Ri05). Other: <T$_{20}$>(3°)=−1.35 *22* (7.5-8.0 MeV) (1976Pe11).
3040 *15*			E(level): from 1963Ja14, 1965Mi04 and 1971Su05.
3317.0 *15*	2$^-$,3$^+$&*c*		<T$_{20}$>=+0.33 *7* (1976Pe11).
3341.2 *16*	1$^+$&*d*		<T$_{20}$>=−0.28 *10* (1976Pe11).
3421.5 *16*			
3431.0 *15*	2$^+$#	2	<T$_{20}$>=+0.51 *9* for 3421+3431 (1976Pe11). E(level): 3422 in 1988Me11.
3458.4 *16*	&		<T$_{20}$>=−0.27 *10* (1976Pe11).
3614.4 *16*			Jπ: possible natural-parity state. <T$_{20}$>=+0.41 *27* (1976Pe11).
3668.9 *19*	3$^+$	2+4	
3688.2 *18*			
3701.3 *19*			
3738.9 *17*			
3790 *20*			
3814.8 *16*	2$^-$&*c*		<T$_{20}$>=+0.33 *15* (1976Pe11).
3841.2 *17*	&		<T$_{20}$>=−0.03 *9* (1976Pe11).
3856.6 *20*	1$^+$&*c*		<T$_{20}$>=+0.26 *12* (1976Pe11).
3935.4 *18*	&		<T$_{20}$>=+0.14 *12* (1976Pe11).
3978.6 *17*	1$^+$&*c*	0+2	L: 2 (1971Su05). <T$_{20}$>=−0.28 *8* (1976Pe11).
4173.8 *20*			
4213.4 *20*			
4318.0 *21*			
4336.7 *21*			
4395.0 *21*			
4412.2 *22*			
4451.7 *22*			
4459.9 *23*			
4491.1 *26*			
4504.9 *23*			
4588.3 *22*			
4616.0 *22*			
4639.0 *22*			
4664 *3*			

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^{40}Ca(d,α),(pol d,α) 1975Co09,1976Pe11,1983Bh05 (continued)

^{38}K Levels (continued)

E(level)[†]	E(level)[†]	E(level)[†]	E(level)[†]	L[e]
4702 *3*	5192 *3*	5676 *3*	5970 *3*	
4718 *3*	5257 *3*	5693 *3*	5983 *4*	
4749.7 *25*	5286 *3*	5730 *3*	6002 *3*	
4806 *3*	5296 *3*	5749 *3*	6022 *4*	
4845 *3*	5307 *3*	5769 *3*	6420[‡] *50*	
4901 *3*	5330 *3*	5795 *3*	6720[‡] *50*	
4971 *3*	5407 *3*	5810 *3*	7000[‡] *50*	
4990 *3*	5439 *3*	5828 *3*	7320[‡] *50*	0+2
5049 *3*	5459 *3*	5851 *3*	9880[‡] *50*	2+4
5086 *3*	5480 *3*	5869 *3*	10260[‡] *50*	
5104 *3*	5601 *3*	5934 *3*		
5131.3 *23*	5617 *3*	5944 *4*		

[†] From 1975Co09, unless otherwise stated.
[‡] From 1983Bh05, likely to be an unresolved multiplet.
[#] From Ay(θ) measurements (1988Me11).
[@] Natural parity state (1976Pe11).
[&] Unnatural parity state (1976Pe11).
[a] T=0 (1963Ja14) from T selection rule.
[b] T=1 (1963Ja14) from T selection rule.
[c] Assignment based partly on the results of 1976Pe11.
[d] Previous assignment consistent with results from 1976Pe11.
[e] From DWBA fit to experimental $\sigma(\theta)$ data in 1983Bh05, unless otherwise stated.