^{40}Ca(α,α') 1981Va09,1967Li13,1965Sp01

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

1981Va09(also 1980Va10): E=120 MeV beam was produced from the KVI cyclotron. Target was 500 μg/cm^2 ^{40}Ca. Scattered particles were detected with two ΔE-E Si surface barrier counter telescopes (FWHM= 90-150 keV) or momentum-analyzed with a magnetic spectrograph (FWHM=50 MeV). Measured $\sigma(\theta)$. Deduced levels, J, π, L, deformation parameters from DWBA analysis; isoscalar multipole strength distribution, EWSR, widths. Report 39 excitation energies up to 21.10 MeV.

1967Li13, 1966Be19: E=31 MeV α beam was produced from the MIT cyclotron. Target was 1 mg/cm^2 natural calcium metal (96.92% in ^{40}Ca). Scattered particles were detected by a silicon surface barrier detector (FWHM=90-100 keV). Measured $\sigma(\theta)$. Deduced levels, J, π, L, deformation parameters from DWBA analysis. Comparisons with theoretical calculations. Report 21 levels up to 8600. This work is an improvement of the work reported in 1965Ba03 by the same authors.

1966Sp01, 1965Sp01 (also 1966Po03): E=50.9 MeV beam was produced from the Berkeley 88-inch cyclotron. Target was 0.64 mg/cm^2 natural Ca (97% in ^{40}Ca). Scattered particles were detected with a Si(Li) detector (FWHM=115 keV). Measured $\sigma(\theta)$. Deduced levels, J, π, L, deformation parameters from DWBA analysis. Report 13 α groups.

1965Ba03: E=30.5 MeV. FWHM=120 keV. An improvement of this work is reported in 1967Li13.

1970Sc24: E=29 MeV; measured $\sigma(\theta)$, θ=15°−176°; deduced levels. Report 27 levels up to 8380.

1974De42: E=24.0, 28.5, 31.0 MeV. Report 12 levels up to 6540.

1981Lu05: E=98.5, 116.8, 129.4 MeV; measured $\sigma(\theta)$. Report 10 excitation energies between 13.2 to 22.5 MeV.

1962Be23: E=22 MeV. About 10 a groups reported.

Data for selected levels or giant resonances:

2003Yo11: E=240 MeV. Measured cross section for isoscalar E0 strength between 6 and 11 MeV at small angles.

2001Yo07, 2001Yo06, 1997Yo07: E=240 MeV; measured $\sigma(\theta)$; deduced E0, E1, E2 widths.

1992Po02: E=120 MeV; measured $\sigma(\theta)$, deduced isoscalar dipole strength.

1983Br21: (α,α'), (α,2α) E=120 MeV; $\sigma(\theta)$ at giant resonance. Deduced monopole strength.

1981Yo04: E=99, 117, 129 MeV.

1979Ro09: E=104 MeV; giant resonances at E=13.3-21.8 MeV.

1978Mo10: E=96,115 MeV; giant resonance near E=8.8 MeV.

1978De25: E=40-62 MeV.

1977Al07: E=1.37 MeV.

1976Ru02: E=79.1 MeV; measured $\sigma(\theta)$, deduced levels, L from DWBA analysis. Report 5 levels.

1976Yo02: E=96, 115 MeV; giant resonance.

1974Ru01 (also 1974RuZS): E=115 MeV; giant resonance.

1973Bi12: E=166 MeV.

1971Ta15: E=166 MeV.

1970Br07: E=44 MeV; $\sigma(\theta)$,θ=15° − 180°.

1968Bu10: E=25 MeV.

1961Sa04: E=44 MeV.

Others:

2014De04: E=136 MeV.

Additional information 1.

1990Fi07: (α,α) E=56 MeV.

1987Se09: E=5-9 MeV.

1985Zw02, 1982Zw01, 1986ZwZZ: (α,α'), (α,2α), (α,αp) E=120 MeV; $\sigma(\theta)$ for giant resonance.

1983Fr03: E=4.4-9.1 MeV.

1981Gu01: E=23-80 MeV.

1980Gi02: E=104 MeV.

1979Ka03: E=65 MeV.

1979Ba14: E=1.37 GeV.

1978Se16: E=6-18 MeV.

1978Gu08,1978Gu25,1978Gu28: E=21-47 MeV.

1978Fr22: E=104 MeV.

1978Lo04: E=36.2-61.0 MeV.

^{40}Ca(α,α') 1981Va09,1967Li13,1965Sp01 (continued)

1977SmZX: E=30 MeV.
1977Bu15: E=27.2 MeV.
1976Eb03: E=20-26 MeV.
1976Ch19: E=24.4-85.6 MeV.
1976Br11: E=166 MeV.
1975Ap01: E=19, 24.1, 26.5 MeV.
1975Tr01: E=24-29 MeV.
1975Mo04: E=96.6 MeV.
1975Le19: E=79.1 MeV.
1975Ei04: E=100 MeV.
1974Go22: E=141.7 MeV.
1974Mo22: E=96 MeV.
1974In02: E=40 MeV.
1974RuZS:
1972St28: E=40.7-72.3 MeV.
1972Oe01: E=24,29 MeV.
1972Br30: E=166 MeV.
1971LeYV: E=166 MeV.
1971Le18: E=18-22 MeV.
1970Fe02: E=42 MeV.
1969La20, 1969La37: E=23 MeV.
1969Jo05 (also 1968JoZZ): E=5.0-12.5 MeV.
1969Ga22: E=18-29 MeV.
1969Be30, 1966Be19: E=29,31 MeV.
1968Ro20: E=12-18 MeV.
1966Gr09: E=27-40 MeV.
1965Ta06: E=22.2 MeV.
1962Sa15: E=43 MeV.

^{40}Ca Levels

E(level)[†]	L[†]	β_LR[‡]	Comments
0	0		
3350 *20*	0	0.07	%EWSR=0.2 (1981Va09). Additional information 2.
3740 *20*	3	0.90	β_LR: others: 0.88 (1970Br07), 0.85 (1965Sp01), 0.90 (sharp cut-off) or 0.97 (smooth cut-off) (1968Bu10), 0.85 (1965Sp01). %EWSR=11.6 (1981Va09). Additional information 3.
3900 *20*	2	0.37	β_LR: others: 0.34 (1965Sp01), β_L=0.097 (1967Li13). %EWSR=3.4 (1981Va09). Additional information 4.
4490 *20*	5	0.39	β_LR: others: 0.38 (1970Br07), 0.53 (sharp cut-off) or 0.58 (smooth cut-off) (1968Bu10), 0.35 (1965Sp01). %EWSR=0.2 (1981Va09). Additional information 5.
5250[#] *20*			E(level): 5250 *20* in 1981Va09 and 5260 *30* in 1967Li13 for the 5250+5280 doublet. Additional information 6.
5280[#]			Additional information 7.
5630 *20*	2	0.13	L: assignment of L=4 in 1965Ba03 is erroneous according to 1967Li13 of the same authors. β_LR: others: β_L=0.046 (1967Li13). %EWSR=0.6 (1981Va09). Additional information 8.
5910 *20*	1		L: (1) from 1981Va09; L=1 from 1967Li13 and 1965Ba03. Other: L=3 with β_LR=0.18 (1965Sp01). Additional information 9.

Continued on next page (footnotes at end of table)

^{40}Ca(α,α') 1981Va09,1967Li13,1965Sp01 (continued)

^{40}Ca Levels (continued)

E(level)†	L†	β_LR‡	Comments
6020 *30*			E(level): from 1967Li13. Also reported in 1974De42 and 1970Sc24; not reported in 1981Va09. Additional information 10.
6160	(3)	0.39	E(level),L,β_LR: from 1961Sa04 and 1970Br07 only. Additional information 11.
6290 *20*	3	0.36	β_LR: other: 0.40 (1965Sp01). %EWSR=3.1 (1981Va09). Additional information 12.
6500 *30*			E(level): from 1967Li13. Additional information 13.
6540@	3	0.31	L: from 1965Ba03. Additional information 14.
6580@	3	0.31	%EWSR=2.4 (1981Va09). Additional information 15.
6740	(3)	0.41	E(level),L,β_LR: from 1961Sa04 and 1970Br07 only. A level at 6790 with adopted J^π=(2$^-$) is reported in 1970Sc24. Additional information 16.
6940 *20*	(3)	0.37	E(level): multiplet since several levels near this energy in Adopted Levels. β_LR: others: 0.21 for L=2 and 0.36 for L=3 (1965Sp01). L: others: L=1+(2) from 1967Li13 and 1965Ba03; none adopted by the evaluator since this level could be an unresolved multiplet. Additional information 17.
7110 *30*			E(level): from 1967Li13. L: the assignment of L=(6) in 1965Ba03 should be discarded according to 1967Li13 of the same authors as 1965Ba03. Additional information 18.
7300			E(level): reported only in 1970Sc24. Additional information 19.
7470& *30*			Additional information 20.
7570& *30*			Additional information 21.
7680 *30*			E(level): from 1967Li13. Additional information 22.
7900 *20*	2	0.28	L: from 1981Va09. Other: 4 (1965Ba03). β_LR: other: β_L=0.078 (1967Li13). %EWSR=3.9 (1981Va09). Additional information 23.
7940 *30*	4	0.29	E(level): from 1967Li13. L: from 1965Sp01, 1966Be19, 1967Li13. β_LR: from 1965Sp01. Other: β_L=0.094 (1967Li13). Additional information 24.
8100 *20*	2	0.22	β_LR: others: 0.24 (1965Sp01), β_L=0.083 (1967Li13). %EWSR=2.5 (1981Va09). Additional information 25.
8290& *30*	(2)		L: from 1967Li13 with β_L=0.049. Additional information 26.
8380 *20*	4	0.21	L: the assignment of L=5 by 1965Ba03 is incorrect according to 1967Li13 of the same authors as 1965Ba03. β_LR: others: 0.24 (1965Sp01), β_L=0.083 (1967Li13). %EWSR=1.1 (1981Va09). Additional information 27.
8600 *20*	2	0.17	β_LR: other: 0.19 (1965Sp01). %EWSR=1.6 (1981Va09). Additional information 28.
8780 *20*	2	0.12	%EWSR=0.8 (1981Va09). Additional information 29.
8970 *20*	(2)	0.13	%EWSR=1.0 (1981Va09). Additional information 30.

Continued on next page (footnotes at end of table)

^{40}Ca(α,α') 1981Va09,1967Li13,1965Sp01 (continued)

^{40}Ca Levels (continued)

E(level)[†]	Γ[a]	L[†]	$\beta_L R$[‡]	Comments
9340 *20*		3	0.17	%EWSR=1.0 (1981Va09). Additional information 31.
9500 *20*				Additional information 32.
9870 *20*				Additional information 33.
10080 *20*				Additional information 34.
10340 *20*		4	0.17	%EWSR=0.8 (1981Va09). Additional information 35.
10590 *20*	0.48 MeV *5*	(3)	0.10	Γ: 0.52 MeV *8* from E=117 MeV data (1981Lu05). L: from 1981Va09. Other: 1 (1981Lu05). %EWSR=0.4 (1981Va09). Additional information 36.
10800 *20*		(3)	0.11	%EWSR=0.5 (1981Va09). Additional information 37.
11100 *20*		(2)	0.27	%EWSR=5.2 (1981Va09). Additional information 38.
11470 *20*		(3)	0.10	%EWSR=0.4 (1981Va09). Additional information 39.
11690 *20*		2	0.14	L: other: 0 (1983Br21). %EWSR=1.5 (1981Va09). Additional information 40.
11940 *20*		(2)	0.15	%EWSR=1.7 (1981Va09). Additional information 41.
12170 *50*		2	0.11	Additional information 42.
12450 *50*	0.16 MeV	3	0.15	Γ: from 1981Va09. Additional information 43.
12720 *50*		(2)	0.09	Additional information 44.
13000 *50*		2	0.11	L: other: 0 (1983Br21). Additional information 45.
13400 *50*	0.40 MeV *8*	0		Γ: 0.36 MeV *6* from E(beam)=117 MeV data (1981Lu05). L: from 1981Lu05 and 1983Br21. Other: L=(2) from 1981Va09 with $\beta_L R$=0.07. other: 0+2 from α decay to ^{36}Ar g.s. (1982Zw01,1983Br21,1985Zw02). %EWSR≈7 (1981Lu05). Additional information 46.
14070 *50*		0	0.05	L: (0) from 1981Va09; L=0 from 1983Br21. Additional information 47.
14260 *50*	1.63 MeV	2	0.37	Γ: from 1981Va09. Additional information 48.
14850 *50*	0.68 MeV *8*	2	0.09	E(level): others: 14.5 MeV *3* (1981Lu05), average energy of 14300 for an excitation region of 13.3-15.3 MeV (1979Ro09). Γ: 0.51 MeV *7* from E(beam)=117 MeV data (1981Lu05). L: other: 1+2 for an excitation region with average energy of 14.3 MeV (1979Ro09). β_L^2=0.0041 for L=1 and 0.0036 for L=2 (1979Ro09). E=14.5 *3*, width=0.68 MeV *8*, L=2 (1981Lu05), 99 MeV data. E=14.6 *3*, width=0.51 MeV *7*, L=2 (1981Lu05), 117 MeV data. Additional information 49.
15140 *50*		(2)	0.09	Additional information 50.
16000 *50*	0.63 MeV *10*	3		Γ: Other: 0.65 MeV from 1981Va09. L: from 1981Lu05. Other: 1+2 (1979Ro09) with β_L^2=0.0033 for L=1 and 0.0024 for L=2; 2 (1981Va09) with $\beta_L R$=0.15. E=15.8 *4*, width=0.63 MeV *10*, L=3 (1981Lu05). Additional information 51.
18000 *50*	2.25 MeV *20*	2	0.69	Γ: 2.53 MeV *40* from E=117 MeV data and 2.56 MeV *40* from E=130 data (1981Lu05), 3.26 MeV (1981Va09), 3.5 MeV *3* (1975Mo04), 3.5 MeV *3* (1976Yo02), 2.9 MeV *6* (2001Yo07).

Continued on next page (footnotes at end of table)

^{40}Ca(α,α') 1981Va09,1967Li13,1965Sp01 (continued)

^{40}Ca Levels (continued)

E(level)[†]	Γ[a]	L[†]	β_LR[‡]	Comments
				β_LR: other: 0.72 (1976Yo02), β_L^2=0.0164 (1979Ro09), β_L=0.14 (1974Ru01). %EWSR=108 *12* (2001Yo07). Additional information 52.
19.18×10^3 *37*	4.9 MeV *6*	0		E(level),Γ,L: from 2001Yo07, %EWSR=97 *11*. Additional information 53.
21100 *50*		0+2	0.18,0.20	L: from 1979Ro09 and 1981Va09. β_LR: other: β_L^2=0.0019 for L=0 and 0.0018 for L=2 (1979Ro09). Additional information 54.
23.36×10^3 *70*	5.3 MeV *9*	1		E(level),Γ,L: from 1997Yo07, 2001Yo07. %EWSR=62 *+10−20* (2001Yo07). Additional information 55.

† From 1981Va09, unless otherwise noted. Data are also available from 1965Ba03, 1967Li13, 1965Sp01, 1981Lu05.

‡ Quoted values are from 1981Va09; data from other measurements are also available and given under comments.

Only 1974De42 report 5250 and 5280 as separate levels. 5250 *20* in 1981Va09 and 5260 *30* in 1967Li13 for the 5250+5280 doublet; 1970Sc24 report a triplet of 5210+5250+5280.

@ Only 1974De42 report 6540 and 6580 as distinct levels. 6570 *20* with β_LR=0.31 from 1981Va09, 6580 with β_LR=0.31 from 1965Sp01, 6560 *3* from 1965Ba03 and 6580 *30* from 1967Li13 for 6540+6580 doublet.

& Reported in 1967Li13 only.

a From E(beam)=99 MeV data in 1981Lu05, unless otherwise noted. Data for E(beam)=117 MeV data from 1981Lu05 are given in comments.