

$^{40}\text{Ca}(\text{p,d}),(\text{pol p,d})$ 1993Ma22

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 149, 1 (2018)	1-Jan-2018

Reaction is (p,d), unless otherwise noted.

1993Ma22 (also **1989Ma16**): (pol p,d) E=65 MeV polarized proton beam was produced from the AVF cyclotron facility of the Research Center for Nuclear Physics, Osaka University. Target was 1.10 mg/cm² natural Ca. Reaction products were momentum-analyzed with the RAIDEN spectrograph (FWHM=25-30 keV) and detected with the focal plane detector system KYUSHU. Measured $\sigma(E,\theta)$, analyzing powers. Deduced Levels, J, π , L-transfer, C²S from DWBA analysis. Reported 80 groups up to 9505 level.

1972Ma23 (also **1972MaXL**): E=40 MeV proton beam was produced from the Grenoble variable-energy cyclotron. Target was 1 mg/cm² natural Ca metal foil. Deuterons were detected in a ΔE -E silicon counter telescope (FWHM=65 keV). Measured $\sigma(E,\theta)$. Deduced levels, L-transfer, C²S from DWBA analysis. Reported 26 groups up to 8310 level.

1975Ka10, **1973Fa10**: E=185 MeV proton beam was produced at the Gustaf Werner Institute of University of Uppsala. Target was 35 mg/cm² natural Ca. Reaction products were momentum-analyzed with a magnetic spectrometer (FWHM=260 keV) and detected in a telescope of a plastic scintillator. Measured $\sigma(E,\theta)$. Deduced levels, J, π , L-transfers, C²S from DWBA analysis. Reported levels at 0, 2470, 2790, 3030, 3940, 4040, 4460, 5130, 5490, 6150, 6910, 7210, 7970.

Others:

1992Ma61: E=65 MeV. Measured $\sigma(\theta)$. DWBA analysis.

1989Ab01: (pol p,d) E=200 MeV. Measured $\sigma(\theta)$ and analyzing powers. Deduced levels, J, π , L, C²S from DWBA analysis for levels at 0, 2470 and 2800.

1984Sm04 (also **1980SmZY**): E=800 MeV. Measured $\sigma(E,\theta)$. DWBA analysis. Reported levels at 0, 2680, 3790, 5400, 6390, 7260, 7780, 10920, 17800.

1980Ho18: (pol p,d) E=65 MeV. Measured $\sigma(\theta)$ and analyzing power for ground state. DWBA analysis.

1980Oh06: E=51.93 MeV. Measured $\sigma(E,\theta)$. DWBA and CCBA analysis. Reported levels at 0, 3630, 3820, 3870, 3940.

1975Ro27: E=65 MeV. Measured $\sigma(E,\theta)$. Deduced C²S from DWBA analysis for g.s. and 2470 levels.

1969Ba05: E=156 MeV. Measured $\sigma(E,\theta)$. Reported levels at 0, 2500, 3300, 3900, 5100, 6100, 7400, 8300. Data were re-analyzed in Nucl Phys A 126, 97 (1969) which reports spectroscopic factors.

1968Ch22: (pol p,d) E=30.5 MeV. Measured $\sigma(\theta)$, analyzing powers. DWBA analysis. Reported levels at 0, 2470, 2800, 5130, 5480, 6150.

1968Ko11: E=33.6 MeV. Measured $\sigma(E,\theta)$. Deduced levels, J, π , L, C²S from DWBA analysis. Reported levels at 0, 2470, 2800, 3030, 5130, 5480, 6150.

1966Ej01 (also **1964Sa10**): E=55 MeV. Measured $\sigma(E,\theta)$. Reported levels at 0, 2500, 4100, 5100, 5400, 6200, 7600, 8500, 10400.

1965GI02: E=27.5 MeV. Measured $\sigma(E,\theta)$. DWBA analysis. Reported levels at 0, 2470, 2800, 3030, 5130, 5480, 6150.

1964Ca02: E=30 MeV. Measured $\sigma(E,\theta)$. Reported g.s and 2650 levels.

1963Ka26 (also **1963Ka30**, **1962Ka19**): E=40 MeV. Measured $\sigma(E,\theta)$.

1970Do10: analyzed $\sigma(\theta)$ in **1965GI02**.

 ^{39}Ca Levels

Cross sections given in comments are from **1975Ka10** at 185 MeV.

E(level) [†]	J π [#]	L [@]	C ² S [@]	Comments
0	3/2 ⁺	2	3.74 20	C ² S: others: 4.0 (1980Oh06), 7.0 (1975Ka10), 1.96 or 1.41 or 1.34 (1989Ab01), 3.0 (1984Sm04), 2.98 (1980Ho18), 4.3 (1975Ro27), 4.2 (1972Ma23), 3.7 (1968Ko11). d σ /d Ω (max)=3.4 mb/sr.
2463 10	1/2 ⁺	0	1.64 15	C ² S: others: 0.48 or 1.20 or 0.56 (1989Ab01), 1.4 (1975Ka10), 1.5 (1975Ro27), 1.9 (1972Ma23), 1.82 (1968Ko11). d σ /d Ω (max)=0.80 mb/sr.
2791 10	7/2 ⁻	3	0.14	C ² S: others: 0.20 (1989Ab01), 0.17 (1975Ka10), 0.21 (1972Ma23), 0.58 (1968Ko11). d σ /d Ω (max)=0.75 mb/sr.
3021 10	3/2 ⁻	1	0.01	C ² S: others: <0.009 (1975Ka10), 0.005 (1972Ma23), 0.02 (1968Ko11).

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$^{40}\text{Ca}(\text{p,d}),(\text{pol p,d})$ **1993Ma22** (continued) ^{39}Ca Levels (continued)

E(level) [†]	J ^π #	L@	C ² S@	Comments
3636 10				dσ/dΩ(max)=0.045 mb/sr. 1980Oh06 interpret this state as 9/2 ⁻ state populated by L=2, J=3/2 transfer from 3740, 3 ⁻ state in ^{40}Ca with C ² S=1.86.
3820 10		(3)	0.04	dσ/dΩ(max)=0.038 mb/sr. L,C ² S: from 1972Ma23.
3886				
3943 10		1	0.031	L: from 1975Ka10 and 1972Ma23. C ² S: from 1975Ka10. Other: 0.006 (1972Ma23). dσ/dΩ(max)=0.16 mb/sr.
4016 10	1/2 ⁺	0	0.097	C ² S: others: <0.1 (1975Ka10), 0.09 (1972Ma23).
4340 10		3		
4432 10		2	0.033	J ^π : 5/2 ⁺ (1993Ma22).
4487 10	7/2 ⁻	3	0.01	L: 1 for a 4460 group in 1975Ka10. C ² S: other: 0.018 (1975Ka10) for L=1, J ^π =3/2 ⁻ .
4926 10		2	0.045	J ^π : (5/2 ⁺) (1993Ma22).
5128 10	5/2 ⁺	2	1.027	C ² S: others: 1.20 (1975Ka10), 1.0 (1972Ma23), 1.43 (1968Ko11). dσ/dΩ(max)=1.05 mb/sr.
5222 10		2	0.076	J ^π : 5/2 ⁺ (1993Ma22).
5316 10	7/2 ⁻	3	0.02	
5364 10				
5400 10				
5484 10	5/2 ⁺	2	0.49	C ² S: others: 0.63 (1975Ka10), 0.45 (1972Ma23), 0.67 (1968Ko11). dσ/dΩ(max)=0.55 mb/sr.
5588 10		2	0.033	J ^π : (5/2 ⁺) (1993Ma22).
5673 10		2	0.016	J ^π : (5/2 ⁺) (1993Ma22).
5720 10		(3)	0.01	J ^π : (7/2 ⁻) (1993Ma22).
5790 10		1	0.01	J ^π : (3/2 ⁻) (1993Ma22).
5851 10		1	0.002	J ^π : (3/2 ⁻) (1993Ma22).
6009 10	(7/2 ⁻)	(3)	0.03	
6094 10	(1/2 ⁺)	(0)	0.038	
6158 10	5/2 ⁺	2	0.94	L: 2 from 1968Ko11. C ² S: others: 0.95 (1975Ka10), 1.1 (1972Ma23), 1.48 (1968Ko11). dσ/dΩ(max)=0.90 mb/sr.
6286 10		2	0.044	J ^π : 5/2 ⁺ (1993Ma22).
6405 10	(7/2 ⁻)	3	0.03	dσ/dΩ(max)=0.31 mb/sr.
6467 10		2	0.079	J ^π : 5/2 ⁺ (1993Ma22).
6514 10		2	0.038	J ^π : (5/2 ⁺) (1993Ma22).
6580 10		3	0.01	J ^π : (7/2 ⁻) (1993Ma22).
6629 10				
6722 10		3	0.01	J ^π : (7/2 ⁻) (1993Ma22).
6794 10		2	0.056	J ^π : 5/2 ⁺ (1993Ma22). C ² S: 0.04 (1972Ma23).
6835 10				
6906 10	1/2 ⁺	0	0.01	L: 2 for 6910 group in 1975Ka10. C ² S: others: 0.14 (1975Ka10) for L=2, J ^π =5/2 ⁺ . dσ/dΩ(max)=0.15 mb/sr.
6954 10		3		
7025 10		(3)		J ^π : (5/2 ⁻) (1993Ma22).
7060 10				
7132 10		2	0.046	J ^π : 5/2 ⁺ (1993Ma22).
7199 10	5/2 ⁺	2	0.197	dσ/dΩ(max)=0.29 mb/sr. C ² S: others: 0.24 (1975Ka10), 0.21 (1972Ma23).
7248 10		2	0.036	J ^π : 5/2 ⁺ (1993Ma22).
7310 10		(3)		
7380 10	5/2 ⁺	2	0.121	C ² S: other: 0.10 (1972Ma23).

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$^{40}\text{Ca}(\text{p,d}),(\text{pol p,d})$ 1993Ma22 (continued) ^{39}Ca Levels (continued)

E(level) [†]	J ^π #	L [@]	C ² S [@]	Comments
7427 10		(2)	0.018	J ^π : (5/2 ⁺) (1993Ma22).
7480 10		(3)		
7532 10		(3)		dσ/dΩ(max)=0.10 mb/sr.
7581 10		(3)		
7635 10		(3)		
7711 10		2	0.046	J ^π : 5/2 ⁺ (1993Ma22).
7773 10				
7840 10				
7924 10	5/2 ⁺	2	0.104	
7972 10	5/2 ⁺	2	0.231	E(level): 7920 (1972Ma23) and 7970 (1975Ka10) probably correspond to 7924+7972 doublet. C ² S: others: 0.33 (1975Ka10,1972Ma23). dσ/dΩ(max)=0.43 mb/sr.
8021 10		2	0.041	J ^π : (5/2 ⁺) (1993Ma22).
8082 10		2	0.031	J ^π : (5/2 ⁺) (1993Ma22).
8157 10	5/2 ⁺	2	0.112	
8219 10		2	0.078	J ^π : 5/2 ⁺ (1993Ma22).
8280 10		2	0.026	J ^π : (5/2 ⁺) (1993Ma22).
8336 10	5/2 ⁺	2	0.142	dσ/dΩ(max)=0.33 mb/sr.
8396 10		2	0.023	J ^π : (5/2 ⁺) (1993Ma22).
8460 10		2	0.052	J ^π : (5/2 ⁺) (1993Ma22).
8509 10		2	0.071	J ^π : 5/2 ⁺ (1993Ma22).
8582 10		2	0.035	J ^π : (5/2 ⁺) (1993Ma22).
8650 10		2	0.019	J ^π : (5/2 ⁺) (1993Ma22).
8692 10	5/2 ⁺	2	0.106	dσ/dΩ(max)=0.21 mb/sr.
8748 10		2	0.025	J ^π : (5/2 ⁺) (1993Ma22).
8806 10		2	0.030	J ^π : (5/2 ⁺) (1993Ma22).
8895 10				
8937 10		2	0.032	J ^π : 5/2 ⁺ (1993Ma22).
8988 10		2	0.038	J ^π : 5/2 ⁺ (1993Ma22).
9039 10		2	0.052	J ^π : 5/2 ⁺ (1993Ma22). dσ/dΩ(max)=0.15 mb/sr.
9104 10		2	0.017	J ^π : (5/2 ⁺) (1993Ma22).
9158 10		2	0.037	J ^π : 5/2 ⁺ (1993Ma22).
9213 10		2	0.026	J ^π : (5/2 ⁺) (1993Ma22).
9271 10				
9329 10				
9426 10				
9505 10				
10.9×10 ³ [‡] 3				
17.8×10 ³ [‡] 5				

[†] From 1993Ma22, unless otherwise noted. Uncertainty is not given in 1993Ma22; ΔE=10 keV is assigned based on FWHM=25-30 keV.

[‡] From 1984Sm04; width ≥500 keV.

From analyzing powers in 1993Ma22. The assignments quoted by 1993Ma22 for levels without analyzing power data are given under comments. 1993Ma22 suggest that L=2 strength in 5-10 MeV excitation region is almost exclusively from d_{5/2}⁻¹ transfer corresponding to deeply-bound hole state.

@ From 1993Ma22, extracted from DWBA fit to experimental differential cross section. Spectroscopic factors are for L+1/2 transfer when J^π is not established by analyzing power; values from other measurements are given under comments, if available.