

$^{37}\text{Cl}(\text{d,p})$ 1990Pi05,1974Fi08,1966Ra12

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Full Evaluation	Jun Chen	NDS 152, 1 (2018)	30-Sep-2017

$J^\pi(^{37}\text{Cl g.s.})=3/2^+$.

1990Pi05: E=12.3 MeV deuteron beam was produced from the cyclotron U120 of the Nuclear Physics Institute of the Czechoslovak Academy of Sciences at Rez. Target were about $50 \mu\text{g}/\text{cm}^2$ CdCl_2 of natural chlorine on $10 \mu\text{g}/\text{cm}^2$ carbon backings. Protons were momentum-analyzed with a multi-range magnetic spectrograph (resolving power $E/\Delta E=2000$) and detected with nuclear emulsion plates. Measured $\sigma(\theta)$. Deduced levels, J, π , L-transfers, spectroscopic factors from DWBA analysis. Comparisons with available data.

1974Fi08: E=12 MeV deuteron beam was produced from the Argonne FN tandem Van de Graaff accelerator. Target was about $100 \mu\text{g}/\text{cm}^2$ LiCl (95.5% enriched in ^{37}Cl). Protons were momentum-analyzed with an Engel split-pole magnetic spectrograph (FWHM ≈ 12 keV) and detected with nuclear emulsions. Measured $\sigma(\theta)$. Deduced levels, J, π , L-transfers, spectroscopic factors from DWBA analysis. Comparisons with available data.

1966Ra12: E=7.5 MeV deuteron beam was produced from the MIT-ONR electrostatic generator. Target was BaCl_2 (99.3% in ^{37}Cl) on a formvar backing. Protons were momentum-analyzed with the MIT multiple-gap magnetic spectrograph (resolving power $E/\Delta E=1000$, corresponding to about 10 keV for proton groups) and detected with nuclear emulsions. Measured $\sigma(\theta)$. Deduced levels, J, π , L-transfers, spectroscopic factors from DWBA analysis. Comparisons with available data.

1962Ho04: E=2.513 MeV. Measured $\sigma(\theta)$. Nine groups reported up to 1986 keV.

 ^{38}Cl Levels

Cross section data: $d\sigma/d\Omega$ (max) mb/sr			
Level	1990Pi05	1974Fi08	1966Ra12
0	≈ 1.1	2.2	0.92
670.9	2.8	4.4	1.95
755.5	3.69	4.6	2.89
1309.0	≈ 2.4	3.6	1.50
1617.3	11.53	14.5	9.6
1692.1	10.19	13.5	8.6
1745.8	4.52	6.5	3.8
1785.0	≈ 0.4	0.68	0.32
1981.0	14.35	20	13.0
2452.5		0.36	1.5
2742.8	12.51	19	10.4
2894.8	1.92	≈ 3.3	1.6
2952.6		≈ 1.9	2.0*
3254.1	2.08	2.9	1.2&
3293.5	3.22	4.2	2.4
3403.6	2.45	3.6	2.2&
3537.6		1.5	1.1#
3565.7		1.5	0.85@
3685.4	4.38	6.5	3.1
3755.8	2.01	3.2	1.4
3821.6	5.39	≈ 8.4	4.7
3862.0	1.65	2.8	1.4
3893.4	14.06	≈ 24	11.1
3936.3	1.77	2.2	1.2
3974.1	7.49	≈ 10.0	5.6
4010.6	3.99	6.6	3.6
4063.0	2.77	4.6	2.3
4286.5	2.71	3.8	2.4
4349.0		≈ 2.7	1.3&
4412.0		≈ 4.0	2.2&
4506.0		3.2	2.3&
4812.5		2.5	0.8*
4834.5	3.22	6.0	2.1
4973			0.4
5068			0.2
5098			0.8

5498

0.8

Note: cross sections are accurate to 10% in 1990Pi05 and 1966Ra12,
15% in 1974Fi08, unless otherwise noted.

*: accurate to 25%

&: accurate to 20%

#: accurate to 30%

@: accurate to 15%

E(level) [†]	L [‡]	(2J+1)S [#]	Comments
0	1+3	0.12,3.60	(2J+1)S: from 1974Fi08. Others: 4.92 (1990Pi05), 4.24 (1966Ra12) for L=3.
670.89 24	3	10.51	E(level): others: 674 5 (1974Fi08), 671 8 (1966Ra12).
			(2J+1)S: others: 7.5 (1974Fi08), 8.56 (1966Ra12).
755.5 3	1+3	0.90,4.59	E(level): others: 758 5 (1974Fi08), 756 8 (1966Ra12).
			(2J+1)S: others: 0.56, 3.80 (1974Fi08); 0.64, 4.12 (1966Ra12).
1309.0 6	3	8.09	E(level): others: 1311 5 (1974Fi08), 1314 8 (1966Ra12).
			(2J+1)S: others: 5.9 (1974Fi08), 6.28 (1966Ra12).
1617.31 10	1	2.84	E(level): others: 1621 5 (1974Fi08), 1621 8 (1966Ra12).
			(2J+1)S: others: 2.0 (1974Fi08), 2.80 (1966Ra12).
1692.08 15	1	2.48	E(level): others: 1696 5 (1974Fi08), 1314 12 (1966Ra12).
			(2J+1)S: others: 1.8 (1974Fi08), 2.44 (1966Ra12).
1745.76 18	1	1.09	E(level): others: 1750 5 (1974Fi08), 1753 12 (1966Ra12).
			(2J+1)S: others: 0.89 (1974Fi08), 1.08 (1966Ra12).
1785.0 16	3	1.21	E(level): others: 1788 5 (1974Fi08), 1790 12 (1966Ra12).
			(2J+1)S: others: 0.94 (1974Fi08), 0.72 for L=2 (1966Ra12).
1981.05 9	1	3.37	E(level): others: 1985 5 (1974Fi08), 1984 12 (1966Ra12).
			(2J+1)S: others: 2.4 (1974Fi08), 3.52 (1966Ra12).
2452.5 16	2@	0.27@	E(level): others: 2452 5 (1974Fi08), 2461 12 (1966Ra12).
			L: weakly populated group in 1990Pi05, L=0 excluded from authors' measurement near 0°, L=2 not excluded.
			(2J+1)S,L: 0.08 (1966Ra12) for L=(0).
2742.83 18	1	2.57	E(level): others: 2748 5 (1974Fi08), 2752 12 (1966Ra12).
			(2J+1)S: others: 1.9 (1974Fi08), 2.56 (1966Ra12).
2894.8 7	1	0.37	E(level): others: 2902 5 (1974Fi08), 2896 15 (1966Ra12).
			(2J+1)S: others: 0.33 (1974Fi08), 0.40 (1966Ra12).
2952.6 16	0@	0.20@	E(level): others: 2954 5 (1974Fi08), 2952 15 (1966Ra12).
			L: weakly populated group in 1990Pi05, L=0 excluded from authors' measurement near 0°.
			(2J+1)S: other: 0.12 (1966Ra12).
3254.1 4	1	0.39	E(level): others: 3255 5 (1974Fi08), 3253 15 (1966Ra12).
			(2J+1)S: other: 0.28 (1974Fi08,1966Ra12).
3293.5 3	1	0.59	E(level): others: 3295 5 (1974Fi08), 3293 15 (1966Ra12).
			(2J+1)S: others: 0.42 (1974Fi08), 0.56 (1966Ra12).
3403.6 3	1	0.44	E(level): others: 3404 5 (1974Fi08), 3405 15 (1966Ra12).
			(2J+1)S: others: 0.35 (1974Fi08), 0.48 (1966Ra12).
3537.6 9	1@	0.15@	E(level): others: 3540 5 (1974Fi08), 3535 15 (1966Ra12).
			(2J+1)S: other: 0.24 (1966Ra12).
3565.7 7	1@	0.15@	E(level): others: 3567 5 (1974Fi08), 3559 15 (1966Ra12).
			(2J+1)S,L: 1.12 for L=2 (1966Ra12).
3685.4 3	1	0.73	E(level): others: 3689 5 (1974Fi08), 3682 15 (1966Ra12).
			(2J+1)S: others: 0.51 (1974Fi08), 0.68 (1966Ra12).
3755.8 8	1	0.33	E(level): others: 3760 5 (1974Fi08), 3750 15 (1966Ra12).
			(2J+1)S: others: 0.24 (1974Fi08), 0.32 (1966Ra12).
3821.57 17	1	0.88	E(level): others: 3826 5 (1974Fi08), 3820 15 (1966Ra12).
			(2J+1)S: others: 0.65 (1974Fi08), 1.00 (1966Ra12).
3862.0 16	1	0.29	E(level): others: 3866 5 (1974Fi08), 3859 15 (1966Ra12).
			(2J+1)S: others: 0.22 (1974Fi08), 0.28 (1966Ra12).
3893.39 11	1	2.27	E(level): others: 3897 5 (1974Fi08), 3891 15 (1966Ra12).
			(2J+1)S: others: 1.7 (1974Fi08), 2.32 (1966Ra12).

Continued on next page (footnotes at end of table)

$^{37}\text{Cl}(\text{d,p})$ **1990Pi05,1974Fi08,1966Ra12** (continued) ^{38}Cl Levels (continued)

E(level) [†]	L [‡]	(2J+1)S [#]	Comments
3936.3 6	1	0.29	E(level): others: 3940 5 (1974Fi08), 3928 15 (1966Ra12). (2J+1)S: others: 0.16 (1974Fi08), 0.24 (1966Ra12).
3974.10 19	1	1.16	E(level): others: 3978 5 (1974Fi08), 3983 15 (1966Ra12). (2J+1)S: others: 0.77 (1974Fi08), 1.16 (1966Ra12).
4010.6 2	1	0.63	E(level): others: 4015 5 (1974Fi08), 4010 15 (1966Ra12). (2J+1)S: others: 0.51 (1974Fi08), 0.72 (1966Ra12).
4063.0 4	1	0.43	E(level): others: 4067 5 (1974Fi08), 4061 15 (1966Ra12). (2J+1)S: others: 0.36 (1974Fi08), 0.48 (1966Ra12).
4286.5 4	1	0.41	E(level): others: 4292 5 (1974Fi08), 4284 15 (1966Ra12). (2J+1)S: others: 0.30 (1974Fi08), 0.48 (1966Ra12).
4349.0 16	1 @	0.21 @	E(level): others: 4352 5 (1974Fi08), 4347 15 (1966Ra12). (2J+1)S: other: 0.28 (1966Ra12).
4412.0 6	1 @	0.31 @	E(level): others: 4417 5 (1974Fi08), 4408 15 (1966Ra12). (2J+1)S: other: 0.44 (1966Ra12).
4506.0 16	1 @	0.24 @	E(level): others: 4511 5 (1974Fi08), 4502 15 (1966Ra12). (2J+1)S: other: 0.48 (1966Ra12).
4812.5 1	1 @	0.15 @	E(level): others: 4818 5 (1974Fi08), 4808 15 (1966Ra12). (2J+1)S: other: 0.16 (1966Ra12).
4834.5 5	1	0.45	E(level): others: 4841 5 (1974Fi08), 4835 15 (1966Ra12). (2J+1)S: others: 0.31 (1974Fi08), 0.40 (1966Ra12).
4973 & 15	(3) &	1.12 &	
5068 & 15	(3) &	0.60 &	
5098 & 15	(2) &	0.32 &	
5498 & 15	(2) &	0.28 &	

[†] From 1990Pi05, unless otherwise stated. Uncertainties given by 1990Pi05 could be underestimated and they seem to be statistical only; the authors claim that the systematic uncertainties have rather low probabilities to be present in their energy determinations because of accurate calibration. The typical uncertainty from measurements of transfer reactions with a magnetic spectrographs is about a few keV. Note that 1974Fi08 give an uncertainty of 5 keV and 1966Ra12 give 8-15 keV from similar proton spectra measured with similar experimental set-up to those in 1990Pi05.

[‡] From 1990Pi05, 1974Fi08 and 1966Ra12, unless otherwise noted.

[#] From 1990Pi05, unless otherwise stated. Values from 1974Fi08 and 1966Ra12 are given under comments. (2J+1)S factors are determined from the following formula: $(d\sigma/d\Omega)(\text{exp}) = N(2J+1)S[d\sigma/d\Omega(\text{DWBA})]/(2J_i+1)$; $N=1.53$, $J_i=3/2$.

@ From 1974Fi08; not given by 1990Pi05.

& From 1966Ra12 only.