

$^{40}\text{Ca}(^3\text{He},\alpha),(\text{pol } ^3\text{He},\alpha)$  1966Hi06,1965Bo15,1965Ya04

Type	Author	History Citation	Literature Cutoff Date
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( $^3\text{He},\alpha$ ) reaction:

**1966Hi06:** E=10.1 MeV  $^3\text{He}$  beam was produced from the 6 MeV Van de Graaff accelerator. Targets with thickness of 50 to 100  $\mu\text{g}/\text{cm}^2$  were prepared by evaporating natural Ca metal onto thin carbon backings of about 8  $\mu\text{g}/\text{cm}^2$ . Reaction products were momentum-analyzed with a 50-cm-radius, single-channel, broad-range spectrograph and detected in nuclear emulsion plates. Measured  $\sigma$ . Deduced levels.

**1965Ya04:** E=24.4 MeV  $^3\text{He}$  beam was produced from the INS cyclotron. Target was 0.77  $\text{mg}/\text{cm}^2$  natural Ca metal evaporated onto a gold foil. Reaction products were momentum-analyzed with a broad-range magnetic spectrograph and detected by emulsions. Measured  $\sigma(\theta)$ . Deduced levels, L-transfers, spectroscopic factors from DWBA analysis. Cross sections are accurate to 20%.

**1965Bo15:** E=18.05 MeV  $^3\text{He}$  beam was produced from the tandem at Max Planck Institut fur Kernphysik on  $^{39}\text{Ca}$  target. Reaction products were detected with an E- $\Delta\text{E}$  solid state counter telescope (FWHM=70 keV) Measured  $\sigma(\theta)$ . Deduced levels, L-transfers, spectroscopic factors from DWBA analysis for g.s., 2470, 2800, 3050, 3970, 4040, 5500, 5150 and 6170 levels.

**1965GI02:** E=30 MeV  $^3\text{He}$  beam was produced at University of Colorado. Target was 0.67  $\text{mg}/\text{cm}^2$  natural Ca. Reaction products were detected with a  $\Delta\text{E}$ -E telescope (FWHM=75 keV). Measured  $\sigma(\theta)$ . Deduced levels, J,  $\pi$ , L-transfers from DWBA analysis for g.s., 2470, 2800 and 5130. Six groups are reported at 0, 2470, 2800, 5130, 5480, 5480 and 6150.

**1965CI04:** E=9.0 MeV  $^3\text{He}$  beam was produced from the variable energy cyclotron at University of Rochester. Target was  $\approx 150$   $\mu\text{g}/\text{cm}^2$  natural Ca metal on polystyrene backing. Measured  $\sigma(\theta)$ . Deduced levels, L-transfers from DWBA analysis. Four groups are reported at 0, 2470, 2800 and 3030.

(pol  $^3\text{He},\alpha$ ) reaction:

**1980Lu03:** E=33.3 MeV polarized  $^3\text{He}$  beam was produced from the University of Birmingham cyclotron. Reaction products were detected with six  $\Delta\text{E}$ -E silicon detector telescopes. Measured  $\sigma(\theta)$ , analyzing powers. Deduced levels, J,  $\pi$ , L-transfers, spectroscopic factors from DWBA analysis for g.s., 2470, 5120 and 6150 levels.

Others: ( $^3\text{He},\alpha$ ) reaction:

**1994Lu14:** E=60 MeV. Measured  $\sigma(\theta)$ ; deduced neutron hole-strength function.

**1984ChZT:** E=132 MeV. Measured  $\sigma(\theta)$ , DWBA.

**1981Gr05:** E=50.4 MeV. Measured  $\sigma(\theta)$ , DWBA for g.s. and 2473 level; deduced optical-model parameters.

**1975Ap01:** E=16-27 MeV. Measured  $\sigma(\theta)$  for g.s. and 2473.

**1973Ro18, 1972Ro10, 1969Ro01:** E=11 MeV, 8 MeV (**1969Ro01**). Measured  $\sigma(\theta)$  for g.s. and 2473.

**1971Ra35:** E=13.0 MeV. Measured  $\sigma(\theta)$  for g.s., 2473 and 2811.

**1970Ba08:** E=12 MeV. Measured  $\sigma(\theta)$ .

**1968Ly01:** E=14-28 MeV. Measured  $\sigma(\theta)$  for g.s. and 2473.

**1967Bo39** (thesis): excitation of isobaric analog states.

**1986Ar12:** E=15 MeV. Yield measurement.

 $^{39}\text{Ca}$  Levels

E(level) <sup>†</sup>	J <sup>π</sup>	L <sup>‡</sup>	C <sup>2</sup> S <sup>‡</sup>	Comments
0	3/2 <sup>+</sup>	2	3.4	J <sup>π</sup> : from L-1/2 transfer based on analyzing power ( <b>1980Lu03</b> ). L: from <b>1965Ya04, 1965Bo15, 1965GI02, 1965CI04, 1971Ra35, 1981Gr05</b> . C <sup>2</sup> S: others: 6.6 ( <b>1968Ly01</b> ), 4.2 ( <b>1965Ya04</b> ), 4.0 ( <b>1965CI04</b> ), 4.3 ( <b>1971Ra35</b> ), 10 ( <b>1973Ro18</b> ), 9.2 ( <b>1975Ap01</b> ), 8.0 ( <b>1980Lu03</b> ), 0.8 ( <b>1981Gr05</b> ).
2473 10	0	1.25		E(level): other: 2470 30 ( <b>1965Ya04</b> ). L: from <b>1965Ya04, 1965Bo15, 1965GI02, 1965CI04, 1971Ra35, 1981Gr05</b> . C <sup>2</sup> S: others: 1.6 ( <b>1968Ly01</b> ), 1.9 ( <b>1965Ya04</b> ), 1.3 ( <b>1971Ra35</b> ), 3.0 ( <b>1973Ro18</b> ), 3.9 ( <b>1975Ap01</b> ), 3.5 ( <b>1980Lu03</b> ), 0.6 ( <b>1981Gr05</b> ).
2799 10	3	0.53		E(level): other: 2800 30 ( <b>1965Ya04</b> ). L: from <b>1965Ya04, 1965Bo15, 1965GI02, 1971Ra35</b> . C <sup>2</sup> S: other: 0.43 ( <b>1971Ra35</b> ).
3032 10	1	0.36		E(level): other: 3030 30 ( <b>1965Ya04</b> ). L,C <sup>2</sup> S: from <b>1965CI04</b> .

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$^{40}\text{Ca}({}^3\text{He},\alpha),(\text{pol } {}^3\text{He},\alpha)$  1966Hi06,1965Bo15,1965Ya04 (continued) $^{39}\text{Ca}$  Levels (continued)

<u>E(level)<sup>†</sup></u>	<u>J<sup>π</sup></u>	<u>L<sup>‡</sup></u>	<u>C<sup>2</sup>S<sup>‡</sup></u>	<u>Comments</u>
3660 20				
3840 20				
3880 20				
3950 20		1	0.07	E(level): other: 3950 30 (1965Ya04).
4020 20		0	0.09	E(level): other: 4020 30 (1965Ya04).
4320 20				
4430? 20				
4490 20				
4610 20				
4710 20				
4920 20				E(level): probably a doublet (1966Hi06).
5070 20		2 <sup>#</sup>	≈4 <sup>#</sup>	E(level): other: 5070 50 (1965Ya04).
5130 20	5/2 <sup>+</sup>	2	1.4	J <sup>π</sup> : from L+1/2 transfer based on analyzing power (1980Lu03). C <sup>2</sup> S: other: 3.9 (1980Lu03). L: 2 (1965G102).
5490 20		2 <sup>#</sup>	≈4 <sup>#</sup>	E(level): other: 5400 50 (1965Ya04). L: (2) from 1965Bo15.
5760 20				E(level): other: 5700 100 (1965Ya04).
6000 20		2 <sup>#</sup>	≈4 <sup>#</sup>	E(level): other: 6050 50 (1965Ya04).
6150 20	5/2 <sup>+</sup>	2	1.54	J <sup>π</sup> : from L+1/2 transfer based on analyzing power (1980Lu03). C <sup>2</sup> S: other: 4.4 from 1980Lu03.

<sup>†</sup> From 1966Hi06; above 5130 the authors report only strong groups.

<sup>‡</sup> From 1965Bo15, unless otherwise noted.

<sup>#</sup> From 1965Ya04.