

$^{32}\text{S}({}^3\text{He},\alpha),(\text{pol } {}^3\text{He},\alpha)$ 1999Ve09,1972Bh01,1970Mo08

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen and Balraj Singh		NDS 184,29 (2022)	24-Jun-2022

- 1999Ve09:** (${}^3\text{He},\alpha$) E=25 MeV. Orsay MP Tandem Van de Graaff. Natural indium sulfide target In_2S_3 . Enge split pole magnetic spectrograph FWHM=38 keV used with a position and angle sensitive drift gas counter. Measured α -spectrum, angular distributions. Shell model calculations and DWBA analysis of the angular distributions. See also **1973BeYE** thesis.
- 1981Ba27:** (pol ${}^3\text{He},\alpha$) E=33 MeV. University of Birmingham Radial Ridge cyclotron. DWBA and CCBA analysis. Measured angular distribution of a few excited states, $A_y(\theta)$.
- 1972Bh01:** (${}^3\text{He},\alpha$) E=18 MeV. University of Pittsburgh Van de Graaff. CdS target. Enge split pole magnetic spectrograph, 13-18 keV FWHM, Ilford K-1 nuclear emulsion plates or 4 position sensitive detectors at the focal plane. Measured α -spectrum, angular distributions. DWBA analysis.
- 1970Mo08:** (${}^3\text{He},\alpha$) E=12 MeV. ONR-CIT tandem accelerator. Both natural CdS targets and CdS depleted in ^{34}S as well as a Sb_2S_3 target for angular distributions of specific levels. Magnetic spectrometer with FWHM=31 keV. 16 Si-Au focal plane detector. Measured α -spectrum, angular distributions. DWBA analysis.
- 1966Aj01:** (${}^3\text{He},\alpha$) E=12.1 MeV. Pennsylvania Tandem Van de Graaff. Antimony sulfide target. Browne-Buechner 65 cm broad range spectrograph, Ilford K-1 nuclear emulsions at focal plane. Measured $E\alpha$. $\theta=15^\circ, 45^\circ$.
- 1966Fo10:** same experimental setup as in **1966Aj01**, measured angular distributions, DWBA analysis.
- 1966Gr26:** (${}^3\text{He},\alpha$) E=12 MeV. MIT-ONR Van de Graaff accelerator. SAgS sandwich target. Broad range multiple-gap Enge-Buechner spectrograph. Kodak NTB nuclear emulsion plates. Measured α spectrum and angular distribution (7.5° – 172.5° in 7.5° steps) of a few states. DWBA analysis.
- Others: **1975In03**, **1970Mc18** (E=8MeV), **1970Ro33**, **1967Ro17**.
- All cross sections ($d\sigma/d\Omega$) listed are from **1972Bh01** at 17.5° , uncertainty is 15%.

 ^{31}S Levels

1972Bh01 put upper limits on $d\sigma/d\Omega$ (at 17.5°) for levels which they did not observe (in $\mu\text{b}/\text{sr}$): E=3077, <120; E=4524, <30; E=5306, <20; E=5438, <30; E=5682, <30; E=6347, <100; E=6394, <100; E=6543, <20; E=6629, <30.

E(level) [†]	J ^π	L&	S [@]	Comments
0	1/2 ⁺ #	0	1.67	$d\sigma/d\Omega=1434 \mu\text{b}/\text{sr}$. L: from 1999Ve09 , 1970Mo08 , 1966Gr26 , 1966Fo10 , 1975In03 . S: others: 0.9 (1966Fo10), 0.96 (1975In03). $C^2S=0.63-0.78$ (1981Ba27).
1245 5	3/2 ⁺ #	2	1.80	$d\sigma/d\Omega=1687 \mu\text{b}/\text{sr}$. E(level): weighted average of 1246 10 (1970Mo08), 1250 10 (1999Ve09), 1245 8 (1972Bh01), 1243 10 (1966Gr26), 1242 20 (1966Aj01). L: from 1999Ve09 , 1966Gr26 , 1966Fo10 , 1975In03 . S: others: 1 (1966Gr26), 1.1 (1966Fo10), 0.7 (1975In03). $C^2S=0.5-0.8$ (1981Ba27).
2230 5	5/2 ⁺ #	2	4.10	$d\sigma/d\Omega=6184 \mu\text{b}/\text{sr}$. E(level): weighted average of 2234 10 (1970Mo08), 2235 10 (1999Ve09), 2230 11 (1972Bh01), 2221 10 (1966Gr26), 2232 15 (1966Aj01). L: from 1999Ve09 , 1966Gr26 , 1966Fo10 , 1975In03 . S: others: 1.6 (1966Gr26), 2.9 (1966Fo10), 2.12 (1975In03) $C^2S=1.3-2.2$ (1981Ba27).
3077 10		0	0.068	$d\sigma/d\Omega<120 \mu\text{b}/\text{sr}$. E(level): weighted average of 3075 10 (1970Mo08), 3081 10 (1999Ve09), 3075 13 (1972Bh01).
3282 5	(5/2) ⁺	2	1.27	L: from 1970Mo08 and 1999Ve09 . $d\sigma/d\Omega=1170 \mu\text{b}/\text{sr}$. E(level): weighted average of 3286 10 (1970Mo08), 3286 10 (1999Ve09), 3281 14 (1972Bh01), 3274 10 (1966Gr26), 3287 15 (1966Aj01). L: from 1970Mo08 , 1999Ve09 , 1966Gr26 , 1966Fo10 . S: others: 0.7 (1966Gr26), 0.8 (1966Fo10).
3352 10				$d\sigma/d\Omega=54 \mu\text{b}/\text{sr}$.

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$^{32}\text{S}(^3\text{He},\alpha),(\text{pol } ^3\text{He},\alpha)$ **1999Ve09,1972Bh01,1970Mo08 (continued)** ^{31}S Levels (continued)

$E(\text{level})^\dagger$	J^π	L&	S@	Comments
3437 10		2 ^a	0.14	E(level): weighted average of 3347 10 (1970Mo08), 3352 10 (1999Ve09) 3341 14 (1972Bh01), 3359 15 (1966Aj01), dσ/dΩ=180 μb/sr. S: for d _{3/2} orbital.
4083 12		2	1.81	E(level): weighted average of 3437 10 (1970Mo08), 3440 10 (1999Ve09), 3434 14 (1972Bh01), 3435 15 (1966Aj01), L: (2) (1970Mo08). E(level): weighted average of 4083 12 (1970Mo08), 4087 10 (1999Ve09), 4076 16 (1972Bh01), 4085 20 (1966Aj01), L: from 1999Ve09, 1970Mo08, 1966Fo10. S: other: 1.1 (1966Fo10).
4207 11 4451 9		3	0.43	E(level): weighted average of 4209 11 (1970Mo08), 4208 25 (1966Aj01), 4200 17 (1972Bh01). dσ/dΩ=500 μb/sr. L: L=2 (1966Fo10) disagrees with L=3 from 1970Mo08 and L=(3) 1999Ve09.
4524 12		2		E(level): weighted average of 4452 9 (1970Mo08), 4451 10 (1999Ve09), 4449 17 (1972Bh01), 4451 15 (1966Aj01), E(level): not observed by 1999Ve09, from 1970Mo08. E(level): weighted average of 4522 12 (1970Mo08), 4526 15 (1966Aj01). L: from 1970Mo08.
4580 9		(4) ^a	0.19	S: for g _{7/2} orbital. dσ/dΩ=80 μb/sr. E(level): weighted average of 4581 9 (1970Mo08), 4579 10 (1999Ve09), 4572 18 (1972Bh01), 4582 15 (1966Aj01). S: 0.19 (1999Ve09).
4602? 18				E(level): from 1972Bh01 only, not resolved from 4572 level. This level is shown as tentative in authors' Table I.
4719 9		2	0.75	dσ/dΩ=35 μb/sr. dσ/dΩ=780 μb/sr. E(level): weighted average of 4717 9 (1970Mo08), 4720 10 (1999Ve09), 4722 18 (1972Bh01), 4718 15 (1966Aj01), L: 2,(3) (1970Mo08), 2 (1999Ve09,1972Bh01). S: 0.75 (1999Ve09), 0.45 (1972Bh01).
4866? 9		(1)		E(level): not observed in 1999Ve09. dσ/dΩ=60 μb/sr.
4966 10		1	0.077	E(level): weighted average of 4870 19 (1972Bh01), 4866 9 (1970Mo08), 4850 30 (1966Aj01). L: from 1970Mo08. Poor DWBA fit to σ(θ) for s _{1/2} or d _{5/2} orbitals (1999Ve09). dσ/dΩ=175 μb/sr.
5026 10				E(level): weighted average of 4968 10 (1970Mo08), 4975 10 (1999Ve09), 4965 19 (1972Bh01), 4976 15 (1966Aj01), L: from 1999Ve09, 1972Bh01, 1970Mo08. S: 0.077 (1999Ve09), 0.06.
5158 10	1/2 ⁺	0	0.19	dσ/dΩ=142 μb/sr. E(level): weighted average of 5026 16 (1970Mo08), 5028 10 (1999Ve09), 5017 19 (1972Bh01). dσ/dΩ=443 μb/sr. E(level): weighted average of 5154 12 (1970Mo08), 5161 10 (1999Ve09), 5154 19 (1972Bh01), 5170 30 (1966Aj01). L: from 1999Ve09, 1972Bh01, 1970Mo08. S: 0.19 (1999Ve09), 0.32 (1972Bh01).
5306 10				E(level): weighted average of 5301 11 (1970Mo08), 5305 10 (1999Ve09) 5315 15 (1966Aj01).
5407 10				E(level): 5407 10 (1970Mo08).
5438 11				E(level): weighted average of 5440 11 (1970Mo08), 5420 30 (1966Aj01).
5519 10				dσ/dΩ=80 μb/sr. E(level): weighted average of 5517 15 (1970Mo08), 5519 10 (1999Ve09), 5509 21 (1972Bh01), 5520 30 (1966Aj01).
5682 10				E(level): weighted average of 5680 10 (1970Mo08), 5677 10 (1999Ve09) 5697 15 (1966Aj01).

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$^{32}\text{S}(^3\text{He},\alpha),(\text{pol } ^3\text{He},\alpha)$ **1999Ve09,1972Bh01,1970Mo08** (continued) ^{31}S Levels (continued)

E(level) [†]	L&	S [@]	Comments
5779 10	2 ^b	0.33	$d\sigma/d\Omega=394 \mu\text{b}/\text{sr}$. E(level): weighted average of 5777 11 (1970Mo08), 5777 10 (1999Ve09), 5774 21 (1972Bh01), 5792 15 (1966Aj01). S: 0.33 (1999Ve09), 0.27 (1972Bh01).
5826 13			$d\sigma/d\Omega=50 \mu\text{b}/\text{sr}$. E(level): weighted average of 5824 13 (1970Mo08), 5840 30 (1966Aj01) 5823 21 (1972Bh01).
5892 10	2 ^b	0.24	$d\sigma/d\Omega=378 \mu\text{b}/\text{sr}$. E(level): weighted average of 5893 10 (1970Mo08), 5889 10 (1999Ve09), 5889 22 (1972Bh01), 5910 30 (1966Aj01), Additional information 1.
5979 10	(4) ^a	0.39	$d\sigma/d\Omega=100 \mu\text{b}/\text{sr}$. E(level): weighted average of 5983 13 (1970Mo08), 5975 10 (1999Ve09), 5978 22 (1972Bh01), 5994 20 (1966Aj01). S: 1.67 (1999Ve09).
6156 12			$d\sigma/d\Omega=105 50 \mu\text{b}/\text{sr}$, partially obscured by α from $^{12}\text{C}(^3\text{He},\alpha)^{11}\text{C}$ in 1972Bh01. E(level): weighted average of 6154 12 (1970Mo08), 6165 25 (1966Aj01), 6150 22 (1972Bh01).
6263 10	0 ^b	0.33	$d\sigma/d\Omega=700 \mu\text{b}/\text{sr}$. E(level): weighted average of 6268 13 (1970Mo08), 6257 10 (1999Ve09), 6258 23 (1972Bh01), 6273 20 (1966Aj01). S: 0.33 (1999Ve09), 0.22 6 (1972Bh01).
6347 13			E(level): weighted average of 6348 13 (1970Mo08), 6340 30 (1966Aj01).
6394 10			E(level): weighted average of 6395 11 (1970Mo08), 6393 10 (1999Ve09), 6400 30 (1966Aj01).
6543 12			E(level): weighted average of 6540 12 (1970Mo08), 6560 30 (1966Aj01).
6593? 15			E(level): 6593 15 (1970Mo08).
6629? 15			E(level): weighted average of 6628 15 (1970Mo08), 6630 30 (1966Aj01).
6712 13			$d\sigma/d\Omega=90 \mu\text{b}/\text{sr}$. E(level): weighted average of 6711 13 (1970Mo08), 6716 24 (1972Bh01).
6749 13			$d\sigma/d\Omega=60 \mu\text{b}/\text{sr}$. E(level): weighted average of 6743 13 (1970Mo08), 6763 20 (1966Aj01), 6746 24 (1972Bh01).
6835 11			$d\sigma/d\Omega=127 \mu\text{b}/\text{sr}$. E(level): 6834 11 (1970Mo08), 6840 30 (1966Aj01), 6838 25 (1972Bh01).
6870 12			E(level): 6862 12 (1970Mo08), 6896 25 (1966Aj01), 6876 25 (1972Bh01).
6978 20	0 ^b	0.05 2	$d\sigma/d\Omega=1000 \mu\text{b}/\text{sr}$. E(level): weighted average of 6966 20 (1999Ve09), 6990 30 (1966Aj01), 6990 25 (1972Bh01). S: from 1972Bh01. Other: 0.03 (1999Ve09).
7036 10	2 ^b	1.52	$d\sigma/d\Omega=2784 \mu\text{b}/\text{sr}$. E(level): weighted average of 7036 11 (1970Mo08), 7033 10 (1999Ve09), 7039 25 (1972Bh01), 7048 20 (1966Aj01). S: other: 1.85 (1972Bh01).
7161 10	2 ^b	0.21	$d\sigma/d\Omega=255 \mu\text{b}/\text{sr}$. E(level): weighted average of 7161 11 (1970Mo08), 7156 10 (1999Ve09), 7163 25 (1972Bh01), 7181 20 (1966Aj01). S: other: 0.21 (1972Bh01).
7194 13			E(level): weighted average of 7199 13 (1970Mo08), 7181 20 (1966Aj01).
7310 11			E(level): from 1970Mo08 only.
7522 [‡] 20			
7600 [‡] 30			
7660 [‡] 30			
7727 10	1+2,1+3 ^a		E(level): L value implies a multiplet. E(level): weighted average of 7726 15 (1970Mo08), 7725 10 (1999Ve09), 7738 20 (1966Aj01).

[†] Weighted average of values from different studies: mainly 1999Ve09, 1970Mo08, 1972Bh01, 1966Aj01, 1966Gr26. 1999Ve09

 ${}^{32}\text{S}({}^3\text{He},\alpha),(\text{pol } {}^3\text{He},\alpha)$ **1999Ve09,1972Bh01,1970Mo08 (continued)**

 ${}^{31}\text{S}$ Levels (continued)

estimated uncertainty to be about 5 keV, but their spectrograph had similar resolution as [1970Mo08](#). For their measurements a more conservative estimate of 10 keV has been adopted.

‡ From [1966Aj01](#) only.

From L-transfer and $A_y(\theta)$ ([1981Ba27](#)). However, fits to analyzing powers are poor.

@ Values are from [1999Ve09](#), unless otherwise stated. [1981Ba27](#) deduced spectroscopic factors derived from a CCBA analysis.

Assuming $s_{1/2}$, $p_{3/2}$, $d_{5/2}$, $f_{7/2}$, $g_{9/2}$ orbitals for $L=0,1,2,3,4$ respectively, except as noted.

& From [1999Ve09](#), [1970Mo08](#), [1966Gr26](#), [1966Fo10](#) and [1975In03](#), except as noted.

^a From [1999Ve09](#).

^b From [1999Ve09](#) and [1972Bh01](#).