

$^{32}\text{S}(\alpha, \alpha')$ 2013It04, 1973Ga30

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2013It04: E=386 MeV α beam was produced from Ring Cyclotron at RCNP, Osaka facility. Targets were 14.3 mg/cm² and 15.6 mg/cm² natural sulfur foils. Reaction products were momentum-analyzed with the Grand-Raiden spectrometer together with multiwire drift chambers and two plastic scintillators. Measured $E\alpha$, $I\alpha$, $\sigma(\theta)$. Deduced levels, J, π , transition strengths from multipole decomposition analysis (MDA) and DWBA analysis. Evidence for SD band structures, and $^{28}\text{Si}+\alpha$ cluster structures.

1973Ga30: E=17.5 MeV α beam was produced from the ANU EN tandem Van de Graaff accelerator. Target was natural CdS with a thickness of about 60 $\mu\text{g}/\text{cm}^2$ on a thin carbon backing. Scattered particles were detected with four surface-barrier detectors (FWHM $\approx$ 40 keV). Measured $\sigma(E\alpha, \theta)$. Deduced levels, J, π , L-transfers.

others:

1974Gr15: E=16.5 MeV. Measured $E\alpha$.
1974An33: E=24.2 MeV. Measured $\sigma(\theta)$.
1972Sc23: E=104 MeV. Measured $\sigma(\theta)$.
1972Oe01: E=24 MeV. Measured $\sigma(\theta)$.
1970Iv04: E=12-17 MeV. Measured $\sigma(\theta)$.
1968Bu10: E=25 MeV. Measured $\sigma(\theta)$. Deduced deformation parameters.
1967Gr13: E=23.8 MeV. Measured $\sigma(\theta)$.
1966Hu11: E=12.2, 13.5, 14.8 and 16.1 MeV. Measured $\sigma(\theta)$.

 ^{32}S Levels

Band assignments are from 2013It04.

E(level) [†]	J π [†]	L [#]	Strength [‡]	Comments
0	N			
2230 10	N			Deformation length $\delta=\beta_2R=0.88$ fm (1968Bu10).
3778 10	N			
4282 10	N			
4459 10	N			
4695 10	U			
5007 10	N			Deformation length $\delta=\beta_2R=0.94$ fm (1968Bu10).
5413 10	U			
5549 10	N			
5798 10	N			
6224 10	U			
6410 10	4 ⁺	4	40.2 22	E(level): other: 6450 50 (2013It04). J π , L: for a group at 6450 (2013It04). Other: π =natural from 1973Ga30.
6581 10	0 ⁺	0	39.8 50	E(level): other: 6590 50 (2013It04). J π , L: for a group at 6590 (2013It04). Other: π =natural from 1973Ga30.
6621 10	U			
6666 10	N			
6762 10	N			
6854 10	4 ⁺	4	22.1 53	E(level): other: 6800 50 (2013It04), probably corresponding to 6762+6854. J π , L: for a group at 6800 (2013It04). Other: π =natural from 1973Ga30.
7117 10	N			E(level): very weak (1973Ga30).
7.48 $\times 10^3$ 5	1 ⁻	1	11 5	E(level): from energy spectrum at $\theta=1.9^\circ$ (2013It04).
7.48 $\times 10^3$ 5	2 ⁺	2	34.1 27	E(level): from energy spectrum at $\theta=3.3^\circ$ (2013It04).
7.65 $\times 10^3$ 5	0 ⁺	0	14.6 10	
7.95 $\times 10^3$ 5	0 ⁺	0	7.2 10	
8.00 $\times 10^3$ 5	3 ⁻	3	1.50 9	
8.49 $\times 10^3$ 5	1 ⁻	1	5.1 6	
8.53 $\times 10^3$ 5	4 ⁺	4	43.5 52	

Continued on next page (footnotes at end of table)

$^{32}\text{S}(\alpha, \alpha')$ **2013It04,1973Ga30 (continued)** ^{32}S Levels (continued)

E(level) [†]	J ^π [†]	Width	L [#]	Strength [‡]	Comments
9.06×10 ³ 5	3 ⁻		3	0.68 9	E(level): from energy spectrum at $\theta=4.8^\circ$ (2013It04).
9.06×10 ³ 5	4 ⁺		4	38.3 50	E(level): from energy spectrum at $\theta=5.6^\circ$ (2013It04).
9.48×10 ³ 5	2 ⁺		2	17.3 20	
9.86×10 ³ 5	3 ⁻		3	0.42 5	
9.88×10 ³ 5	1 ⁻		1	6.2 12	
10.30×10 ³ 5	4 ⁺		4	27.4 70	
10.49×10 ³ @ 5	0 ⁺		0	10.6 6	
10.88×10 ³ @ 5	2 ⁺		2	30.8 26	
10.89×10 ³ 5	3 ⁻		3	0.52 18	
10.92×10 ³ 5	1 ⁻		1	19.0 14	
11.62×10 ³ & 5	0 ⁺		0	29.4 24	
11.71×10 ³ 5	1 ⁻		1	8.0 21	
11.73×10 ³ & 5	2 ⁺		2	19.3 18	
11.90×10 ³ ^a 5	0 ⁺		0	18.7 24	
12.06×10 ³ ^a 5	2 ⁺		2	42.3 21	
12.19×10 ³ @ 5	4 ⁺		4	52.3 70	
12.51×10 ³ 5	2 ⁺		2	16.3 7	
12.63×10 ³ & 5	4 ⁺		4	27.4 23	
13.33×10 ³ 5	2 ⁺		2	24.1 9	
13.40×10 ³ ^a 5	4 ⁺		4	29.8 24	
13.97×10 ³ 5	4 ⁺		4	22.2 40	
22.42×10 ³ 74		9.41 MeV	2		E(level): isoscalar giant quadrupole resonance. Uncertainty=+0.65–0.83 MeV. E2 EWSR=143% +9–12 (2013It04). Γ: rms width (2013It04).
23.65×10 ³ 63		9.43 MeV	0		E(level): isoscalar giant monopole resonance. Uncertainty=+0.60–0.66 MeV. E0 EWSR=108% +7–8 (2013It04). Γ: rms width (2013It04).
>25×10 ³			(4)		E(level): E4 resonance (2013It04).
31.4×10 ³ 75			3		E(level): high-energy octupole resonance. Uncertainty=+0.5–1.0 MeV (2013It04).
<50×10 ³			1		E(level): isoscalar giant dipole resonance. E1 EWSR=103% 11 (2013It04).

[†] From 1973Ga30 up to 7117 level and from 2013It04 above that, unless otherwise noted. Spin-parities are deduced from analysis of measured $\sigma(\theta)$, where N is for natural parity and U for unnatural from 1973Ga30 based on comparisons with the shapes of $\sigma(\theta)$ of levels with known spin-parities.

[‡] Isoscalar giant resonance strength from MDA analysis in 2013It04, with units of fm⁴ for E0 and E2, fm⁶ for E1, 10³fm⁶ for E3, and 10⁵fm⁸ for E4.

[#] From MDA and DWBA analysis of $\sigma(\theta)$ in 2013It04.

@ Band(A): Possible SD-1 band.

& Band(B): Possible SD-2 band.

^a Band(C): Possible SD-3 band.

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Band(C): Possible SD-3
band

4⁺ 13400

Band(B): Possible SD-2
band

4⁺ 12630

Band(A): Possible SD-1
band

4⁺ 12190

2⁺ 12060

0⁺ 11900

2⁺ 11730

0⁺ 11620

2⁺ 10880

0⁺ 10490