^{28}Si(α,α):resonances 2011Lo02,2003Ka07,1996Ka44

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 201,1 (2025)	31-Oct-2024

2011Lo02: E=19-31 MeV beam produced from the K=36 cyclotron at Oslo. Measured excitation functions and angular distributions of α particles detected by Si detectors with resolution of 17-25 keV Deduced resonance, L values from R-Matrix analysis. Discussion in terms of α-cluster structure in the quasi-continuum of ^{32}S. 2011Lo02 state that some of the resonances at such high energies group into band-like structures.

2003Ka07: E=12.0-19.6 MeV α beam was from the Abo Akademi accelerator, Laboratory Uppsala using the K-20 isochronous cyclotron, and E=6.5-12.8 MeV using beams from the Tandem van de Graaff accelerator at Sveldberg laboratory. Target was thick natural Si, 92.2% ^{28}Si. Measured $\sigma(\theta)$. Also from the same group: 1998Br29, 1995Lu11, 1992Ar12, 1996Ka44 (E=3.6-5.8 MeV), 1994Ma46, thesis by K.-M. Kallman (Abo Akademi University, 1998), 2003Br26, 2008No07.

Other: 1962Wi03, 1975Mo04.

^{32}S Levels

E(level)[†]	J$^{\pi}$[†]	WIDTH[†]	L[†@]	γ_{α}^2[#]	Comments
10369	0^+	5.8 keV			Eα(lab)=3910. Γ_{α}=4.0 keV.
10500	0^+	1.7 keV			Eα(lab)=4060. Γ_{α}=1.0 keV.
10570	0^+	1.2 keV			Eα(lab)=4140. Γ_{α}=0.5 keV.
10658	1^-	2.3 keV			Eα(lab)=4240. Γ_{α}=1.0 keV.
10745	0^+	8.9 keV			Eα(lab)=4340. Γ_{α}=4.0 keV.
10816	3^-	4.7 keV			Eα(lab)=4420. Γ_{α}=1.4 keV.
10868	2^+	7.7 keV			Eα(lab)=4480. Γ_{α}=0.5 keV.
10956	0^+	2.9 keV			Eα(lab)=4580. Γ_{α}=0.4 keV.
11104	2^+	67.4 keV			Eα(lab)=4750. Γ_{α}=6.0 keV.
11130	0^+	1.8 keV			Eα(lab)=4780. Γ_{α}=1.5 keV.
11253	3^-	1.1 keV			Eα(lab)=4920. Γ_{α}=0.1 keV.
11410	3^-	1.9 keV			Eα(lab)=5100. Γ_{α}=0.3 keV.
11629	3^-	5.7 keV			Eα(lab)=5350. Γ_{α}=1.3 keV.
11690	3^-	1.2 keV			Eα(lab)=5420. Γ_{α}=0.6 keV.
11848	3^-	10.4 keV			Eα(lab)=5600. Γ_{α}=2.0 keV.
11953	2^+	3.2 keV			Eα(lab)=5720. Γ_{α}=1.0 keV.
12049	3^-	7.0 keV			Eα(lab)=5830. Γ_{α}=2.0 keV.
12198	3^-	6.4 keV			Eα(lab)=6000. Γ_{α}=2.0 keV.
12710[‡]		5 keV	(5)		Γ_{α}/Γ=0.56.
12770[‡]		10 keV	(2)		Γ_{α}/Γ=0.20.
12830[‡]		1 keV	(3)		Γ_{α}/Γ=0.05.
12860[‡]		38 keV	(3)		Γ_{α}/Γ=0.63.
12910[‡]		8 keV	(3)		Γ_{α}/Γ=0.40.
12930		29 keV *5*	(3)	16 *10*	Eα(lab)=6834. Γ_{α}=16 keV *10*.
13086		26 keV *7*	(3)	5 *3*	Eα(lab)=7012. Γ_{α}=6 keV *4*.
13268		49 keV *3*	(3)	12.7 *8*	Eα(lab)=7220. Γ_{α}=17.9 keV *12*.
13370		28.8 keV *13*	(3)	8.6 *5*	Eα(lab)=7337. Γ_{α}=12.8 keV *8*.
13490		54 keV *5*	(3)	16.1 *17*	Eα(lab)=7474. Γ_{α}=28 keV *3*.
13588		18 keV *4*	(3)	4.0 *12*	Eα(lab)=7586. Γ_{α}=8 keV *2*.
13655		74 keV *2*	(3)	24.5 *9*	Eα(lab)=7663. Γ_{α}=50 keV *2*.
13696		23.6 keV *9*	(4)	14.1 *7*	Eα(lab)=7710. Γ_{α}=12.3 keV *6*.
13807		47.4 keV *8*	(3)	20.6 *4*	Eα(lab)=7836. Γ_{α}=27.9 keV *10*.
13870		22.0 keV *11*	(5)	10.5 *6*	Eα(lab)=7908. Γ_{α}=11.0 keV *6*.
13896		22.4 keV *1*	(4)	26.2 *14*	Eα(lab)=7938. Γ_{α}=8.8 keV *5*.
14070		29.6 keV *7*	(3)	9.6 *3*	Eα(lab)=8137. Γ_{α}=27.3 keV *8*.
14131		15.2 keV *6*	(5)	15.0 *7*	Eα(lab)=8207. Γ_{α}=6.6 keV *3*.
14177		42.0 keV *11*	(4)	18.1 *8*	Eα(lab)=8259. Γ_{α}=25.4 keV *11*.
14234		89 keV *2*	(3)	21.5 *5*	Eα(lab)=8324. Γ_{α}=69 keV *2*.

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^{28}Si(α,α):resonances 2011Lo02,2003Ka07,1996Ka44 (continued)

^{32}S Levels (continued)

E(level)†	WIDTH†	L†@	γ_α^2#	Comments
14429	40 keV *2*	(3)	11.8 *6*	Eα(lab)=8547. Γ_α=41 keV *2*.
14542	84.5 keV *11*	(4)	34.4 *8*	Eα(lab)=8676. Γ_α=66 keV *2*.
14633	7.0 keV *9*	(5)	2.6 *4*	Eα(lab)=8780. Γ_α=2.0 keV *3*.
14832	37.5 keV *5*	(4)	13.9 *3*	Eα(lab)=9008. Γ_α=33.2 keV *6*.
14878	25.5 keV *7*	(4)	6.0 *2*	Eα(lab)=9060. Γ_α=14.8 keV *5*.
15025	30.5 keV *11*	(4)	7.6 *6*	Eα(lab)=9229. Γ_α=21 keV *2*.
15116	36 keV *2*	(5)	13.6 *12*	Eα(lab)=9332. Γ_α=15.8 keV *14*.
15230	18 keV *2*	(4)	1.6 *2*	Eα(lab)=9463. Γ_α=5.1 keV *7*.
15344	45.9 keV *1*	(5)	16.5 *5*	Eα(lab)=9593. Γ_α=23.0 keV *7*.
15385	24.5 keV *6*	(5)	9.4 *3*	Eα(lab)=9640. Γ_α=13.6 keV *4*.
15441	34.3 keV *3*	(5)	16.4 *4*	Eα(lab)=9704. Γ_α=24.7 keV *5*.
15527	46.8 keV *3*	(5)	15.4 *6*	Eα(lab)=9802. Γ_α=24.8 keV *9*.
15631	29.9 keV *3*	(5)	16.0 *2*	Eα(lab)=9921. Γ_α=27.9 keV *4*.
15686	35.9 keV *1*	(5)	9.3 *4*	Eα(lab)=9984. Γ_α=16.7 keV *7*.
15758	41.0 keV *9*	(6)	32.2 *10*	Eα(lab)=10066. Γ_α=20.0 keV *6*.
15847	47 keV *2*	(4)	7.6 *6*	Eα(lab)=10168. Γ_α=33 keV *2*.
15894	28.0 keV *8*	(5)	8.8 *3*	Eα(lab)=10222. Γ_α=18.5 keV *7*.
15955	21.6 keV *5*	(6)	19.5 *6*	Eα(lab)=10291. Γ_α=14.4 keV *4*.
16052	54 keV *2*	(5)	12.0 *7*	Eα(lab)=10402. Γ_α=28 keV *2*.
16243	41.3 keV *8*	(6)	20.1 *5*	Eα(lab)=10620. Γ_α=18.8 keV *5*.
16341	86 keV *2*	(5)	17.1 *5*	Eα(lab)=10732. Γ_α=47.1 keV *14*.
16495	64 keV *3*	(5)	12.7 *10*	Eα(lab)=10908. Γ_α=39 keV *3*.
16615	60 keV *2*	(6)	30.3 *12*	Eα(lab)=11046. Γ_α=38 keV *2*.
16691	23 keV *2*	(5)	3.7 *8*	Eα(lab)=11132. Γ_α=12 keV *3*.
16747	45 keV *2*	(6)	17 *2*	Eα(lab)=11197. Γ_α=23 keV *3*.
16795	76 keV *6*	(6)	29 *2*	Eα(lab)=11251. Γ_α=41 keV *3*.
16866	38.1 keV *6*	(6)	18.8 *4*	Eα(lab)=11333. Γ_α=27.8 keV *6*.
16920	35.0 keV *8*	(6)	9.4 *3*	Eα(lab)=11394. Γ_α=14.4 keV *5*.
16978	47 keV *3*	(6)	11.0 *10*	Eα(lab)=11461. Γ_α=18 keV *2*.
17080	58.0 keV *14*	(6)	19.1 *7*	Eα(lab)=11577. Γ_α=32.5 keV *13*.
17250	92 keV *14*	(5)	22 *6*	Eα(lab)=11771. Γ_α=96 keV *27*.
17393	35 keV *6*	(7)	31 *26*	Eα(lab)=11935. Γ_α=20 keV *17*.
17656	36 keV *2*	(7)	20.6 *10*	Eα(lab)=12235. Γ_α=16.4 keV *8*.
17688	26 keV *2*	(7)	13.2 *12*	Eα(lab)=12272. Γ_α=10.8 keV *10*.
17868	82 keV *7*	(6)	13.1 *11*	Eα(lab)=12478. Γ_α=35 keV *3*.
17934	48 keV *4*	(7)	20 *2*	Eα(lab)=12553. Γ_α=20 keV *2*.
18042	44 keV *2*	(7)	25.3 *12*	Eα(lab)=12677. Γ_α=26.4 keV *12*.
18213	76 keV *7*	(7)	24 *6*	Eα(lab)=12872. Γ_α=28 keV *7*.
18458	66 keV *5*	(7)	11.2 *9*	Eα(lab)=13152. Γ_α=15.2 keV *12*.
18554	73.6 keV *14*	(7)	19.7 *5*	Eα(lab)=13262. Γ_α=28.3 keV *7*.
18660	74 keV *5*	(7)	25 *2*	Eα(lab)=13383. Γ_α=38 keV *3*.
18736	75 keV *6*	(7)	18 *2*	Eα(lab)=13470. Γ_α=29 keV *2*.
18803	46 keV *3*	(8)	27 *2*	Eα(lab)=13546. Γ_α=12.9 keV *10*.
18986	34 keV *2*	(8)	22 *2*	Eα(lab)=13755. Γ_α=11.9 keV *10*.
19119	84 keV *7*	(8)	38 *6*	Eα(lab)=13907. Γ_α=23 keV *4*.
19248	54 keV *10*	(8)	23 *5*	Eα(lab)=14055. Γ_α=15 keV *3*.
19442	72 keV *2*	(7)	10.9 *3*	Eα(lab)=14276. Γ_α=25.4 keV *7*.
19551	75 keV *18*	(8)	22 *6*	Eα(lab)=14401. Γ_α=18 keV *4*.
19653	54 keV *2*	(8)	37.4 *13*	Eα(lab)=14518. Γ_α=31.6 keV *11*.
19747	79 keV *9*	(8)	22 *3*	Eα(lab)=14625. Γ_α=20 keV *3*.
20275	44 keV *4*	(7)	4.5 *3*	Eα(lab)=15228. Γ_α=15.1 keV *10*.
20381	72 keV *17*	(8)	18 *8*	Eα(lab)=15350. Γ_α=24 keV *10*.
20485	84 keV *4*	(8)	15.2 *8*	Eα(lab)=15468. Γ_α=20.8 keV *11*.
20703	37 keV *4*	(8)	4.4 *7*	Eα(lab)=15718. Γ_α=6.7 keV *10*.

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^{28}Si(α,α):resonances 2011Lo02,2003Ka07,1996Ka44 (continued)

^{32}S Levels (continued)

E(level)[†]	WIDTH[†]	L[†@]	γ_α^2[#]	Comments
20835	59 keV *2*	(8)	10.1 *5*	Eα(lab)=15869. Γ_α=16.5 keV *8*.
21212	69 keV *3*	(9)	25.6 *13*	Eα(lab)=16299. Γ_α=15.0 keV *8*.
21395	70 keV *5*	(9)	17.3 *12*	Eα(lab)=16509. Γ_α=11.2 keV *8*.
21457	45 keV *4*	(9)	9.2 *10*	Eα(lab)=16579. Γ_α=6.2 keV *7*.
21532	39 keV *10*	(9)	9 *6*	Eα(lab)=16665. Γ_α=6 keV *2*.
21783	53 keV *2*	(8)	8.9 *3*	Eα(lab)=16952. Γ_α=22.4 keV *8*.
22135	74 keV *4*	(9)	15.3 *12*	Eα(lab)=17354. Γ_α=14.9 keV *11*.
22205	54 keV *9*	(9)	12 *4*	Eα(lab)=17434. Γ_α=12 keV *4*.
22308	47 keV *14*	(9)	9 *6*	Eα(lab)=17552. Γ_α=10 keV *7*.
22355	24 keV *5*	(8)	1.4 *4*	Eα(lab)=17606. Γ_α=4.6 keV *13*.
22846	51 keV *5*	(9)	5.9 *8*	Eα(lab)=18167. Γ_α=8.3 keV *11*.
22964	58 keV *3*	(10)	20.3 *14*	Eα(lab)=18395. Γ_α=8.1 keV *6*.
23226	74 keV *16*	(9)	8 *2*	Eα(lab)=18601. Γ_α=14 keV *3*.
23296	52 keV *7*	(9)	6.3 *13*	Eα(lab)=18681. Γ_α=10 keV *2*.
23493	93 keV *12*	(10)	31 *4*	Eα(lab)=18906. Γ_α=17 keV *2*.
23.86×10^3	≈0.1 MeV	7		E(α)(lab)=19.33 MeV.
24.93×10^3	≈0.1 MeV	8		E(α)(lab)=20.55 MeV.
26.90×10^3	≈0.2 MeV	11		E(α)(lab)=22.80 MeV.
27.25×10^3	0.08 MeV	9		E(α)(lab)=23.20 MeV.
27.44×10^3	0.04 MeV	8		E(α)(lab)=23.38 MeV.
27.69×10^3	0.15 MeV	9		E(α)(lab)=23.65 MeV.
27.82×10^3	0.11 MeV	9		E(α)(lab)=23.84 MeV.
28.04×10^3	0.04 MeV	10		E(α)(lab)=24.08 MeV.
28.17×10^3	0.07 MeV	10		E(α)(lab)=24.28 MeV.
28.30×10^3	0.08 MeV	8		E(α)(lab)=24.40 MeV.
28.48×10^3	0.17 MeV	10		E(α)(lab)=24.64 MeV.
28.67×10^3	0.22 MeV	10		E(α)(lab)=24.85 MeV.
28.97×10^3	0.19 MeV	10		E(α)(lab)=25.15 MeV.
29.25×10^3	0.13 MeV	9		E(α)(lab)=25.50 MeV.
29.66×10^3	0.16 MeV	10		E(α)(lab)=25.95 MeV.
29.88×10^3	0.20 MeV	10		E(α)(lab)=26.12 MeV.
29.91×10^3	0.16 MeV	10		E(α)(lab)=26.24 MeV.
30.26×10^3	0.17 MeV	9		E(α)(lab)=26.64 MeV.
30.37×10^3	0.13 MeV	10		E(α)(lab)=26.76 MeV.
30.61×10^3	0.25 MeV	11		E(α)(lab)=27.03 MeV.
30.89×10^3	0.14 MeV	12		E(α)(lab)=27.39 MeV.
31.19×10^3	0.20 MeV	12		E(α)(lab)=27.72 MeV.
31.71×10^3	0.22 MeV	9		E(α)(lab)=28.30 MeV.
31.98×10^3	0.22 MeV	12		E(α)(lab)=28.60 MeV.
32.7×10^3	≈0.3 MeV			E(α)(lab)=29.43 MeV.
33.5×10^3	≈0.2 MeV			E(α)(lab)=30.34 MeV.

[†] From 2011Lo02 above 23.8 MeV; from 2003Ka07 between 12.9 MeV and 23.8 MeV; from 1996Ka44 below 12.9 MeV. E(level)=Eα(c.m.)+S(α)(^{32}S), where S(α)(^{32}S)=6947.6559 *14* (2021Wa16). Spin-parities are from analysis of measured $\sigma(\theta)$.

[‡] Quoted by 2011Lo02 from thesis by K.-M. Kallman (Abo Akademi University, 1998).

[#] Reduced Γ.

[@] Values for excitations up to 23.8 MeV are tentative because the sample fits authors provide are unconvincing and don't use standard R-Matrix comparison. Above 23.8 MeV, the L values from 2011Lo02 are based on standard R-matrix formalism.