

$^{29}\text{Si}(\alpha, n\gamma)$ 1997Br07, 1973Ca18, 2017Pe14

Type	Author	History Citation	Literature Cutoff Date
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1997Br07: E=14.4 MeV α beam was from 7-MV Van de Graaff accelerator of the University of Freiburg. Target was 300 $\mu\text{g}/\text{cm}^2$ SiO_2 (88% enriched in ^{29}Si) on a tantalum backing. Neutrons were detected with 19 liquid scintillator detectors in a quasi annular array and γ rays were detected with two Ge(Li) detectors. Measured $E\gamma$, $I\gamma$, $n\gamma$ -coin, $n\gamma(\theta)$, Doppler-shift attenuation. Deduced levels, J, π , lifetimes, γ -ray multipolarities, mixing ratios. A 15% systematic uncertainty from stopping power theory is assumed.

1973Ca18: E=9.5 MeV α beam was from Oliver Lodge Laboratory, Liverpool. γ rays were detected with Ge(Li) and NaI(Tl) detectors. Measured $E\gamma$, $I\gamma$, Doppler-shift attenuation. Deduced levels, lifetimes, γ -ray branching ratios. A 25% systematic uncertainty is assumed from uncertainty in slowing down theory.

2017Pe14: E=9 MeV ^4He beam from Cologne FN tandem accelerator. Target was 0.5 mg/cm^2 ^{29}S on 5.0 mg/cm^2 thick Ta foil. γ rays were detected with 12 HPGe detectors. Measured $E\gamma$, $I\gamma$, $\gamma\gamma$ -coin, Doppler-shift attenuation. Deduced levels, lifetimes, B(E2). Authors discussed past (1970's) DSAM measurements using Blaugrund approximation for stopping powers, and related problems leading to lower lifetimes. A systematic uncertainty of 6% is assumed due to incomplete knowledge of stopping power theory.

Others:

1983Fr16: E=12 and 14 MeV α beams were from the CN Van de Graaff accelerator at Strasbourg Centre de Recherches Nucleaires University Louis Pasteur. γ rays were detected with Ge(Li) detectors. Measured $E\gamma$, $n\gamma(\theta)$. Deduced levels, J, π .

1972Ga43: E=8.7, 8.8 and 9.8 MeV α beam was from the ANU EN tandem accelerator. Target was SiO_2 (92% enriched) with a thickness of about 200 $\mu\text{g}/\text{cm}^2$ on a tantalum backing. γ rays were detected with a Ge(Li) detector. Measured $E\gamma$, $\gamma(\theta)$, Doppler-shift attenuation. Deduced level, J, lifetime for the 5800 level.

 ^{32}S Levels

E(level) [†]	J π [‡]	T _{1/2} [†]	Comments
0	0 ⁺		
2230	2 ⁺	205 fs 16	T _{1/2} : from DSAM in 2017Pe14. Additional information 1.
3778.4 10	0 ⁺	0.88 ps 7	T _{1/2} : weighted average of 1.01 ps 26 (1973Ca18) and 0.87 ps 7 (2017Pe14). Additional information 2.
4281.5 5	2 ⁺	71 fs 27	T _{1/2} : unweighted average of 44 fs 26 (1973Ca18) and 98 fs 11 (2017Pe14). Additional information 3.
4461	4 ⁺		
4697 1	1 ⁺	286 fs 74	Additional information 4.
5006 1	3 ⁻	0.55 ps 14	Additional information 5.
5412 1	3 ⁺	139 fs 39	Additional information 6.
5548.5 10	2 ⁺	45 fs 6	T _{1/2} : unweighted average of 46 fs 12 (1973Ca18) and 45 fs 6 (2017Pe14). Additional information 7.
5800 2	1 ⁻	9.7 fs 49	J ^π : spin=1 from $n\gamma(\theta)$ in 1972Ga43. T _{1/2} : from DSAM in 1972Ga43. Other: <7fs (1973Ca18). Additional information 8.
6226 1	2 ⁻	69 fs 18	Additional information 9.
6412 2		24 fs 8	Additional information 10.
6622 2	(3,4) ⁻	1.05 ps 30	Additional information 11.
6668			
6762	5		E(level): from 1983Fr16. J ^π : spin=5 from $n\gamma(\theta)$ in 1983Fr16. Additional information 12.
6852	4		Additional information 12.
7566.8 9	5	104 fs 22	Additional information 13.
7950.1 14		0.15 ps +15-10	Additional information 14.
8270.3 14	3,5	<42 fs	Additional information 15.
8346.4 14	4,6	<28 fs	Additional information 16.
9023.8 21	4,6	184 fs 38	Additional information 17.
9170 3			
9235.2 24		<42 fs	Additional information 18.

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$^{29}\text{Si}(\alpha, n\gamma)$ **1997Br07, 1973Ca18, 2017Pe14 (continued)** ^{32}S Levels (continued)

E(level) [†]	J ^π [‡]	T _{1/2} [†]	Comments
9463.4 10	5,7	<49 fs	Additional information 19.
9634.6 18	4,6	62 fs 38	Additional information 20.
9783.0 20	6	94 fs +87-73	Additional information 21.

[†] From [1973Ca18](#) for levels below 6670 and from [1997Br07](#) above this energy, unless otherwise noted. A systematic uncertainty of 25% from slowing down theory as stated in [1973Ca18](#) is added in quadrature by the evaluators; uncertainties from [1997Br07](#) includes a 15% uncertainty from slowing down theory.

[‡] From n γ (θ) in [1997Br07](#) for levels above 6762 and from Adopted Levels for others.

$\gamma(^{32}\text{S})$								
E _i (level)	J _i ^π	E _{γ} [†]	I _{γ} [†]	E _f	J _f ^π	Mult. [#]	$\delta^{\#}$	Comments
2230	2 ⁺	2230		0	0 ⁺			
3778.4	0 ⁺	1548		2230	2 ⁺			
4281.5	2 ⁺	2052	7 2	2230	2 ⁺			
		4282	93 2	0	0 ⁺			
4461	4 ⁺	2231		2230	2 ⁺			
4697	1 ⁺	2467	58 3	2230	2 ⁺			
		4697	42 3	0	0 ⁺			
5006	3 ⁻	2776	97 1	2230	2 ⁺			
		5006	3 1	0	0 ⁺			
5412	3 ⁺	3182		2230	2 ⁺			
5548.5	2 ⁺	3319	62 6	2230	2 ⁺			
		5549	38 6	0	0 ⁺			
5800	1 ⁻	5800		0	0 ⁺			A ₂ =-0.38 6, A ₄ =+0.06 6 at E _{α} =8.8 MeV, and A ₂ =-0.31 6, A ₄ =-0.10 6 (1972Ga43).
6226	2 ⁻	3996		2230	2 ⁺			
6412		4182		2230	2 ⁺			
6622	(3,4) ⁻	1616	73	5006	3 ⁻			
		2161	24	4461	4 ⁺			
		4392	2	2230	2 ⁺			
6668		2890	49	3778.4	0 ⁺			
		4438	51	2230	2 ⁺			
6762	5	1755 [‡]		5006	3 ⁻	Q		A ₂ =+0.40 4, A ₄ =-0.15 5 (1983Fr16). Mult.: not given in 1983Fr16 , but implied from n γ (θ).
		2303 [‡]		4461	4 ⁺			
6852	4	2393		4461	4 ⁺	D+Q	-0.93 +26-44	A ₂ =-0.36 5, A ₄ =+0.07 8 (1983Fr16). A ₂ =-0.21 14, A ₄ =-0.4 24 (1997Br07). A ₂ =+0.43 7, A ₄ =-0.39 13 (1997Br07).
		2570		4281.5	2 ⁺	Q		
7566.8	5	2154	30 10	5412	3 ⁺			
		3108.4 [‡]	12	70 10	4461	4 ⁺	E2(+M1) +10 +16-4	A ₂ =+0.22 8, A ₄ =+0.61 14 (1997Br07). A ₂ =+0.07 8, A ₄ =+0.67 10 (1983Fr16).
7950.1		2944	100	5006	3 ⁻			
8270.3	3,5	3264	100	5006	3 ⁻			A ₂ =+0.46 10, A ₄ =-0.71 18 (1997Br07). Mult., δ : $\delta(Q/D)$ =+1.5 +14-70 for J=3; Mult=Q for J=5 (1997Br07).
8346.4	4,6	3886.1 [‡]	15	100	4461	4 ⁺		A ₂ =+0.34 9, A ₄ =-0.31 15 (1997Br07). A ₂ =+0.30 7, A ₄ =-0.20 9 (1983Fr16). Mult., δ : $\delta(Q/D)$ =+1.5 4 for J=4; Mult=Q for J=6 (1997Br07).
9023.8	4,6	2262	70 6	6762	5			Mult., δ : $\delta(Q/D)$ =-4.3 +16-97 for J=6, >4

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$^{29}\text{Si}(\alpha, n\gamma)$ **1997Br07, 1973Ca18, 2017Pe14 (continued)** $\gamma(^{32}\text{S})$ (continued)

$E_i(\text{level})$	J_i^π	E_γ^\dagger	I_γ^\dagger	E_f	J_f^π	Mult. #	Comments
9023.8	4,6	2402	30 6	6622	(3,4) ⁻		for J=4 (1997Br07). A ₂ =-0.45 9, A ₄ =+0.46 16 (1997Br07). Mult., δ : $\delta(\text{Q/D})=+1.5 +10-6$ for J=4; Mult=Q for J=6 (1997Br07). A ₂ =+0.36 18, A ₄ =-0.58 32 (1997Br07).
9170		4711	100	4461	4 ⁺		
9235.2		3822	50 5	5412	3 ⁺		
		4776	50 5	4461	4 ⁺		
9463.4	5,7	2702.1 [‡] 15	100	6762	5		Mult., δ : $\delta(\text{Q/D})=+0.82 +24-19$ for J=5; Mult=Q for J=7 (1997Br07). A ₂ =+0.51 5, A ₄ =-0.38 9 (1997Br07). A ₂ =+0.34 7, A ₄ =-0.39 9 (1983Fr16).
9634.6	4,6	3015.3 [‡] 15	100	6622	(3,4) ⁻		Mult., δ : $\delta(\text{Q/D})=+1.1 3$ for J=4; Mult=Q for J=6 (1997Br07). A ₂ =+0.39 9, A ₄ =-0.26 15 (1997Br07). A ₂ =+0.38 9, A ₄ =-0.37 11 (1983Fr16).
9783.0	6	5324	100	4461	4 ⁺	E2	Mult.: Q from $n\gamma(\theta)$; M2 ruled out by RUL. A ₂ =+0.31 6, A ₄ =-0.18 8 (1997Br07).

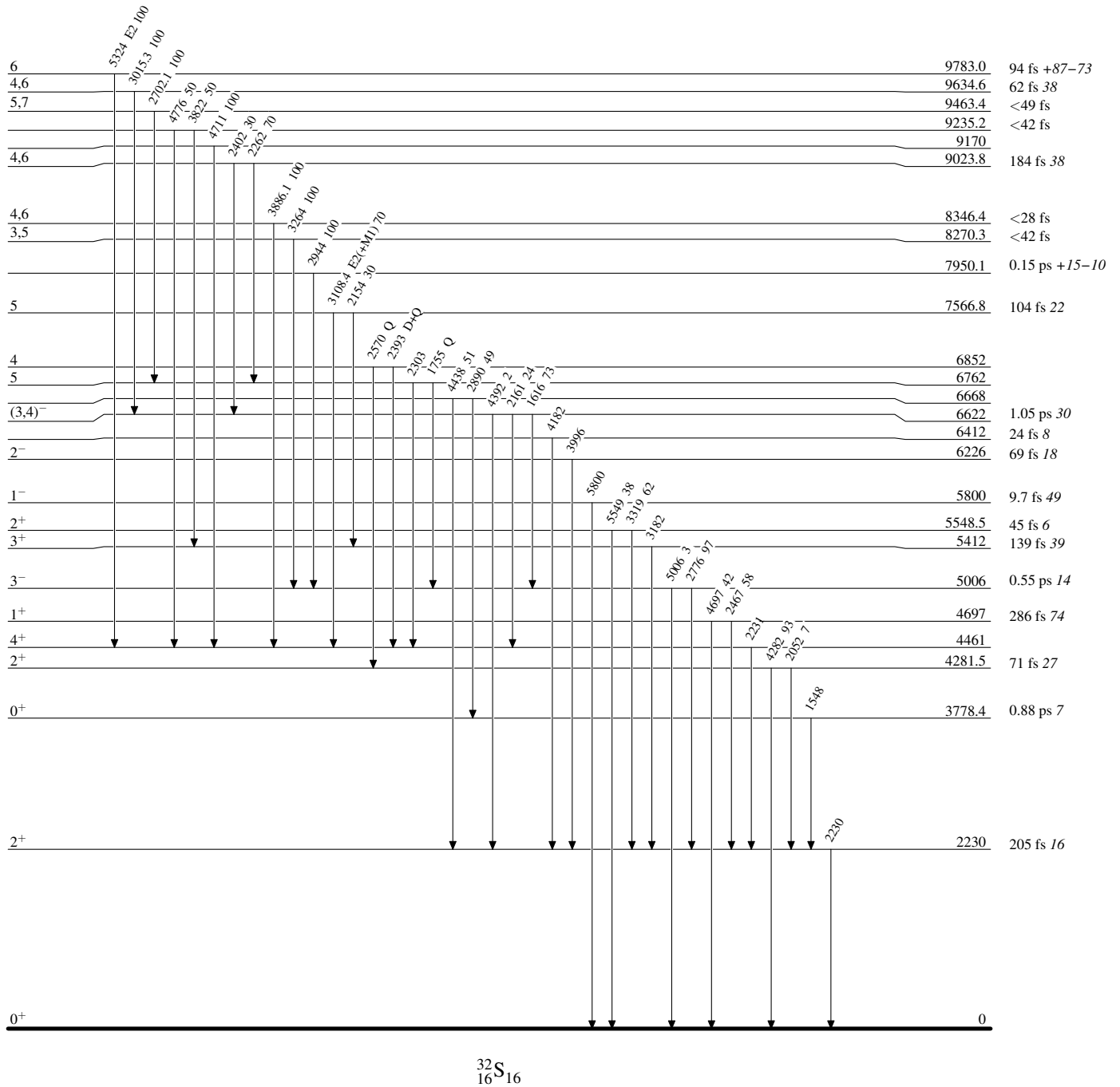
[†] From 1973Ca18 for levels below 6670 and from 1997Br07 above this energy, unless otherwise noted.

[‡] From 1983Fr16.

From $n\gamma(\theta)$ in 1997Br07, with magnetic or electric nature determined based on RUL where $T_{1/2}$ available.

$^{29}\text{Si}(\alpha, n\gamma)$ 1997Br07,1973Ca18,2017Pe14Level Scheme

Intensities: % photon branching from each level

 $^{32}_{16}\text{S}_{16}$