^{28}Si(^{3}He,nγ) 1973Ku15,1972Ca22,1982Al22

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	M. S. Basunia, A. Chakraborty	NDS 197,1 (2024)	31-May-2024

Others: 1960Jo10, 1961Ro30, 1963Fr10, 1970Bi08, 2011Se03, 2012Lo14, 2013Se08, 2017Pe14.

1973Ku15: ^{28}Si(^{3}He,n) E=7.0-10.0 MeV; Target: natural Si or 99.6% enriched ^{28}Si; Ge(Li) detector, NE213 scintillation counter and NaI(Tl) detector; Measured: n-γ-γ coin, Eγ, γ-ray branching, γ-ray angular correlation, lifetime using the Doppler shift attenuation technique.

1972Ca22: ^{28}Si(^{3}He,nγ) E=6.5-10 MeV; NE213, Ge(Li) and NaI(Tl) detectors; Measured: Eγ, branching ratio, deduced mean lifetimes using Doppler shift attenuation technique.

1982Al22: ^{3}He(^{28}Si,nγ) E=60 MeV; NE213 and Ge(Li) detectors, p-γ coin; deduced mean lifetimes for the 1st and 2nd excited states using Doppler shift attenuation technique.

1970Bi08: ^{28}Si(^{3}He,nγ) E=4-8 MeV.

2011Se03,2013Se08: ^{3}He beam, E=9 MeV; Target of a 25 μm thick foil of natural silicon. Two high-purity Ge detectors (70% and 140% efficiency) for detecting γ-rays, FWHM=3.5 keV. Measured Eγ, Iγ, $\gamma\gamma$-coin. Deduced levels, γ ray branching ratios.

^{30}S Levels

E(level)[†]	J$^{\pi}$[‡]	T$_{1/2}$	L	Comments
0	0$^+$	1.42 s *10*		T$_{1/2}$: Weighted average of 1.35 s *10* (1961Ro30 − 511γ(t)) and 1.5 s *1* (1960Jo10), 1.4 s *1* (1963Fr10 − β(t)).
2210.15 *20*	2$^+$[&]	172 fs *28*		T$_{1/2}$: unweighted average of 100 fs *35* (1973Ku15), 121 fs *35* (1970Bi08), 215 fs 52 (1972Ca22) and 176 fs *15* (1982Al22 − τ=254 fs *23*), 246 fs *26* from mean lifetime τ=355 fs *37* (2017Pe14).
3404.3 *4*	2$^+$[&]	121 fs *15*	2	T$_{1/2}$: weighted average of 80 fs *28* (1973Ku15), 111 fs *31* (1972Ca22) and 117 fs 15 (1982Al22 − τ=169 fs *21*), 166 fs *24* (2017Pe14 − τ=239 fs *35*). All by DSAM.
3667.4 *8*	(0$^+$)[&]	>1 ps		J$^{\pi}$: from isotropic $\gamma(\theta)$ (2012Lo14). T$_{1/2}$: >1 ps (both in 1973Ku15 and 1972Ca22).
3676.7 *5*	(1$^+$)[&]	97 fs *55*		J$^{\pi}$: 1 or 3 from $\gamma(\theta)$ and DCO; 1$^+$ from mirror analogue of ^{30}Si (2012Lo14). 1 from n$\gamma(\theta)$ (1973Ku15). T$_{1/2}$: from 1973Ku15.
4687.66 *23*	(3$^+$)[#&]			J$^{\pi}$: 1 or 3 from $\gamma(\theta)$ and DCO; 3$^+$ from mirror analogue of ^{30}Si (2012Lo14).
4808.8 *4*	(2$^+$)[#@]			J$^{\pi}$: also from triton angular distributions and mirror analogue of ^{30}Si (2013Se08).
5132.1 *3*	(4$^+$)[@&]	38 fs *14*		T$_{1/2}$: from 1973Ku15.
5218.8 *3*	3$^+$[@]			
5848.1 *5*	4$^+$[@]			

[†] From a least-squares fit to Eγ.
[‡] From 1973Ku15, except otherwise noted. J$^{\pi}$ based on model calculation and γ-ray correlation studies.
[#] Tentative assignments from 2011Se03.
[@] From $\gamma(\theta)$, DCO, and mirror analogue of ^{30}Si (2012Lo14).
[&] From $\gamma(\theta)$ and DCO (2013Se08).

γ(^{30}S)

R$_{DCO}$=Iγ(≈135°)/Iγ(≈90°) (2013Se08). Expected values are: 1.0 for ΔJ=0, dipole; 0.5 for ΔJ=1, dipole and 1.0 for ΔJ=2, quadrupole, when gated on ΔJ=2, quadrupole transitions.

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^{28}Si(^{3}He,nγ) 1973Ku15,1972Ca22,1982Al22 (continued)

$\gamma(^{30}S)$ (continued)

E_γ[†]	I_γ[&]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[a]	δ	Comments
[x]846.0[@] *4*	3.9[@] *6*							I_γ: at 90°. Other: 2.8 *5* at 135° (2013Se08).
1193.4 *7*	44.9 *2*	3404.3	2^+	2210.15	2^+	D+Q	+0.16	A_2=+0.06 *1*; A_4=0.00 *2*; DCO=1.12 *4* (2012Lo14) A_2=+0.38 *25*; A_4=−0.14 *22*; DCO=0.92 *4* (2013Se08) E_γ: others: Weighted average of 1194.1 *1* (2012Lo14) and 1194.0 *1* (2013Se08 − previous value 1193.8 *1* (2011Se03)), 1192.0 *5* (1973Ku15). I_γ: others: 33.5 *5* at 90° and 43.3 *10* at 135° gated by 2210γ (2013Se08). δ: from $\gamma(\theta)$ data (2013Se08).
1283.4	2.6 *1*	4687.66	(3^+)	3404.3	2^+			A_2=−0.10 *9*; A_4=−0.11 *11*; DCO=0.44 *16* (2012Lo14) DCO=0.37 *4* (2013Se08) E_γ: from 2012Lo14. Same value in 2013Se08 (previous value: 1283.3 *17* (2011Se03)). I_γ: others: 1.2 *2* at 90° gated by 1194γ and γ not observed at 135° (2013Se08). Iγ(1283.4)/Iγ(2477.4)=20.5(36)/100(6) (2011Se03 − from Iγ(1283.4)/Iγ(2477.4)=17(3)/83(5)).
1404.5 *2*	3.1 *1*	4808.8	(2^+)	3404.3	2^+			A_2=+0.12 *12*; A_4=−0.05 *15*; DCO=1.13 *13* (2012Lo14) E_γ: weighted average of 1404.5 *1* (2012Lo14), 1405.1 *4* (2013Se08 − previous value 1405.7 (2011Se03)). I_γ: others: 3.1 *4* at 90° and 1.9 *4* at 135° gated by 1194γ (2013Se08).
1457.2 *7*	3.2 *1*	3667.4	(0^+)	2210.15	2^+	Q		A_2=−0.01 *11*; A_4=−0.13 *13*; DCO=0.90 *10* (2012Lo14) DCO=0.94 *9* (2013Se08) E_γ: weighted average of 1457.9 *4* (2012Lo14) and 1456.5 *3* (2013Se08). I_γ: others: 11 *3* at 90° and 13.9 *9* at 135° gated by 2210γ (2013Se08).
1466.5 *4*	2.3 *1*	3676.7	(1^+)	2210.15	2^+	D+Q	−0.09 *3*	A_2=−0.09 *13*; A_4=−0.12 *14*; DCO=0.41 *34* (2012Lo14) DCO=0.40 *8* (2013Se08) E_γ: weighted average of 1467.0 *4* (2012Lo14) and 1466.2 *3* (2013Se08). I_γ: others: 3.1 *1* at 90° and 3.6 *6* at 135° gated by 2210γ (2013Se08). Branching: 67 *17* for Iγ(3676)=100(17) (1973Ku15). δ: from 2013Se08.
1814.4[#] *3*	1.4 *8*	5218.8	3^+	3404.3	2^+			A_2=−0.32 *11*; A_4=+0.02 *12*; DCO=0.56 *34* (2012Lo14)
2210.1 *2*	100.0 *7*	2210.15	2^+	0	0^+	Q		A_2=+0.42 *4*; A_4=−0.56 *5* (1973Ku15) A_2=+0.14 *1*; A_4=−0.08 *2*; DCO=1.21 *3* (2012Lo14) A_2=+0.4 *2*; A_4=−0.01 *18* (2013Se08) E_γ: weighted average of 2209.9 keV *11* (1972Ca22), 2210.0 *1* (2012Lo14), 2210.6 *3* (2013Se08 − previous value 2210.9 *3* (2011Se03)).

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^{28}Si(^{3}He,nγ) 1973Ku15,1972Ca22,1982Al22 (continued)

$\gamma(^{30}S)$ (continued)

E_γ[†]	I_γ[&]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[a]	δ	Comments
								I_γ: others: 100 *1* at 90° and 135° gated by 2210γ (2013Se08).
2477.4 *1*	14.8 *2*	4687.66	(3$^+$)	2210.15	2$^+$	D+Q	+0.73 *9*	A_2=−0.47 *3*; A_4=−0.04 *4*; DCO=0.51 *2* (2012Lo14) E_γ: weighted average of 2477.4 *1* (2012Lo14), 2477.3 *3* (2013Se08 − previous value 2477.1 *2* (2011Se03)). I_γ: others: 6.0 *4* at 90° and 9.3 *9* at 135° gated by 2210γ (2013Se08). δ: from 2013Se08.
2598.8 *4*	3.1 *1*	4808.8	(2$^+$)	2210.15	2$^+$			E_γ: weighted average of 2598.6 *4* (2012Lo14), 2599.0 *4* (2013Se08 − previous value 2599.5 *5* (2011Se03)). I_γ: others: Iγ(2598.8)/Iγ(1404.5)=59(11)/100(13) (2011Se03 − from Iγ(2598.8)/Iγ(1404.5)=37(7)/63(8)).
2921.8 *2*	26.7 *2*	5132.1	(4$^+$)	2210.15	2$^+$	Q		A_2=+0.52 *13*; A_4=−0.02 *17* (1973Ku15) A_2=+0.37 *2*; A_4=−0.12 *3*; DCO=1.28 *3* (2012Lo14) DCO=0.99 *11* (2013Se08) E_γ: weighted average of 2921.8 *1* (2012Lo14), 2921.4 *4* (2013Se08 − previous value 2921.8 *2* (2011Se03)), 2925 *2* (1973Ku15). I_γ: others: 9.7 *4* at 90° and 18.3 *10* at 135° gated by 2210γ (2013Se08).
3008.5[#] *2*	5.5 *1*	5218.8	3$^+$	2210.15	2$^+$			A_2=−0.28 *9*; A_4=+0.03 *11*; DCO=0.59 *10* (2012Lo14)
3402.6 *13*	11.2 *18*	3404.3	2$^+$	0	0$^+$	Q		A_2=+0.37 *10*; A_4=+0.20 *13* (1973Ku15) I_γ: from Iγ(3402.6)/Iγ(1193.4)=25(4)/100(4) (1973Ku15).
3637.7[#] *4*	4.5 *1*	5848.1	4$^+$	2210.15	2$^+$	Q		A_2=+0.30 *4*; A_4=−0.05 *6*; DCO=1.30 *8* (2012Lo14)
3676[‡]	3.4 *11*	3676.7	(1$^+$)	0	0$^+$	D		A_2=−0.31 *11*; A_4=−0.12 *15* (1973Ku15) I_γ: from Iγ(3676)/Iγ(1466)=100(17)/67(17) (1973Ku15).

† Weighted/Unweighted value of the measured Eγ listed in comments, except otherwise noted.
‡ Deduced from the level energy difference by the evaluators.
# From 2012Lo14.
@ From 2011Se03.
& From 2012Lo14, except where otherwise noted.
a From $\gamma(\theta)$ and γ-ray angular correlations.
x γ ray not placed in level scheme.

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Level Scheme

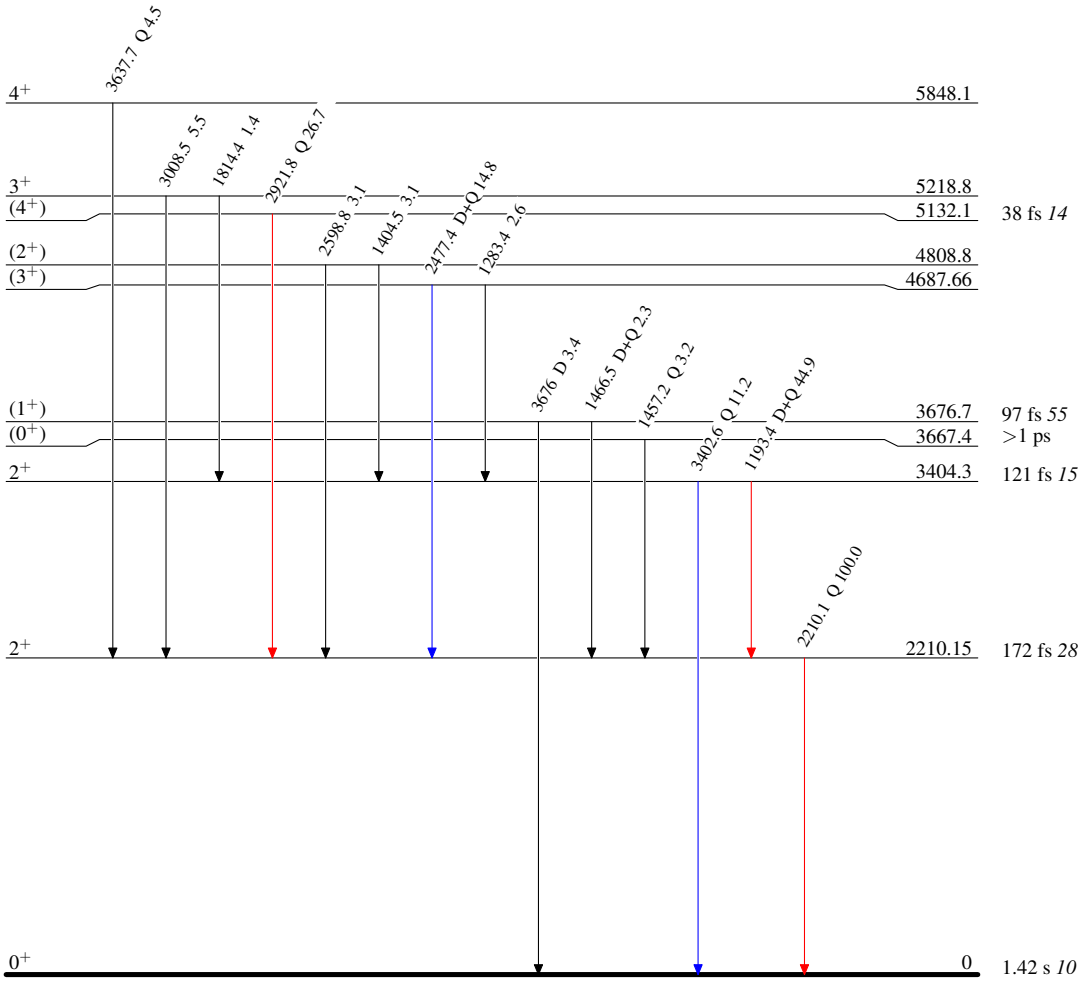
Intensities: Relative I_γ

Legend

$I_\gamma < 2\% \times I_\gamma^{max}$

$I_\gamma < 10\% \times I_\gamma^{max}$

$I_\gamma > 10\% \times I_\gamma^{max}$



$^{30}_{16}S_{14}$