^{30}Si(α,pγ) 1975Ni01,1973Ca20,1968Mo16

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen and Balraj Singh	NDS 199,1 (2025)	30-Sep-2024

1975Ni01: E=13.5 and 17 MeV α beams were produced at the Oliver Lodge Laboratory of the University of Liverpool. Targets were 150 μg/cm^2 self-supporting foils of ^{30}Si (>95% enriched). Charged particles were detected with a E-ΔE annular counter telescope and γ rays were detected with five NaI(Tl) crystals and a Ge(Li) detector. Measured Eγ, Iγ, pγ-coin, p$\gamma(\theta)$, γ(lin pol), recoil-distance. Deduced levels, J, π, $T_{1/2}$, γ-ray branching ratios, transition strengths, and mixing ratios. Comparisons with available data.

1973Ca20: E=7.00-10.00 MeV α beams were produced at the Oliver Lodge Laboratory of the University of Liverpool. Targets were 115 μg/cm^2 ^{30}Si and 700 μg/cm^2 $^{30}SiO_2$ both on Au backings, 95% enriched in ^{30}Si. γ rays were detected with a Ge(Li)-NaI(Tl) escape-suppressed and pair-escape spectrometer. Measured Eγ, Iγ, $\gamma(\theta)$, Doppler-shift attenuation (DSA). Deduced levels, $T_{1/2}$.

1968Mo16: E=8 MeV ^{4}He beam was produced from the 4-MeV Van de Graaff accelerator of the Duke University. Target was 150 μg/cm^2 SiO^2, 95.5% enriched in ^{30}Si. Protons were detected with a annular surface-barrier detector and γ rays were detected with a NaI(Tl) crystal and a coaxial Ge(Li) detector. Measured Eγ, Iγ, pγ-coin, p$\gamma(\theta)$. Deduced levels, J, π, γ-ray branching ratios, multipolarities and mixing ratios. Comparisons with available data.

1969Cu01,1967Cu01: E=9.5 MeV α beam was produced from the Harwell Van de Graaff accelerator. Target was highly-enriched ^{30}Si. Protons were detected with a surface-barrier detector and γ rays were detected with a NaI(Tl) or a Ge(Li) detectors. Measured Eγ, Iγ, pγ-coin, Doppler-shift attenuation (DSA). Deduced levels, $T_{1/2}$, γ-ray transition strengths.

1969Ha40: E=16.5 MeV α beam was produced from the Argonne accelerator. Target was about 200 μg/cm^2 carbon-backed ^{30}Si, 95.55% enriched. Protons were detected with an annular surface-barrier detector and γ rays were detected with two Ge(Li) detectors. Measured Eγ, Iγ, pγ-coin, p$\gamma(\theta)$. Deduced levels, J, π, γ-ray branching ratios, multipolarities and mixing ratios. See also (α,p) dataset for proton spectroscopy data from 1969Ha40.

Additional information 1.

^{33}P Levels

E(level)[†]	J$^\pi$	$T_{1/2}$[‡]	Comments
0.0	1/2$^+$		J$^\pi$: from the Adopted Levels.
1431.83 *20*	3/2$^+$	0.41 ps *9*	J$^\pi$: 3/2 from 1432$\gamma(\theta)$ in 1968Mo16 and 1969Ha40. $T_{1/2}$: from τ=596 fs *133*, weighted average of 525 fs *133* (1973Ca20) and 790 fs *220* (1969Cu01).
1847.96 *20*	5/2$^+$	0.89 ps *12*	J$^\pi$: 5/2 from 1850$\gamma(\theta)$ in 1968Mo16. $T_{1/2}$: from τ=1278 fs *170*, weighted average of 1200 fs *300* (1973Ca20) and 1360 fs *170* (1969Cu01) by DSAM, and 1200 fs *200* (1975Ni01) by RDM.
2539.8 *5*	3/2$^+$	<7 fs	J$^\pi$: from p-2540$\gamma(\theta)$ in 1968Mo16; parity from the Adopted Levels. $T_{1/2}$: from τ<10 fs (1973Ca20).
3491.84 *35*	3/2,5/2	30 fs *23*	E(level): other: 3489 *2* from 1973Ca20. J$^\pi$: from p-2061$\gamma(\theta)$ in 1969Ha40. $T_{1/2}$: from τ=43 fs *33* (1973Ca20).
3628 *1*	7/2$^+$	111 fs *39*	Additional information 2. E(level): from 1973Ca20. J$^\pi$: from p$\gamma(\theta)$ of 1780γ and 2196γ in 1969Ha40; parity from the Adopted Levels. $T_{1/2}$: from τ=160 fs *56* (1973Ca20).
4226.55 *28*	7/2$^-$		J$^\pi$: from the Adopted Levels.
5453.17 *34*	9/2$^-$	24[#] ps *5*	J$^\pi$: from p$\gamma(\theta)$ and γ(lin pol) in 1975Ni01. $T_{1/2}$: from τ=35 ps *7* (1975Ni01).
5638.58 *34*	11/2$^-$	9.7[#] ps *14*	J$^\pi$: from p$\gamma(\theta)$ and γ(lin pol) in 1975Ni01. $T_{1/2}$: from τ=14 ps *2* (1975Ni01).

[†] From a least-squares fit to γ-ray energies with uncertainties, unless otherwise noted.

[‡] From DSAM in 1973Ca20 and 1969Cu01, unless otherwise noted. A 25% uncertainty from stopping power quoted by 1973Ca20

Continued on next page (footnotes at end of table)

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^{33}P Levels (continued)

has been added in quadrature by the evaluators to original uncertainties in 1973Ca20.
From RDM in 1975Ni01.

$\gamma(^{33}P)$

E_i(level)	J_i^π	E_γ †	I_γ †	E_f	J_f^π	Mult.	δ	Comments
1431.83	3/2$^+$	1431.8 *2*	100	0.0	1/2$^+$	M1+E2	−0.60 *11*	E_γ: other: 1435 *3* (1968Mo16). I_γ: from 1968Mo16. Mult.: D+Q from p$\gamma(\theta)$; E1+M2 ruled out by RUL. δ: weighted average of −0.63 *17* (1968Mo16) and −0.58 *11* (1969Ha40).
1847.96	5/2$^+$	416	6 *2*	1431.83	3/2$^+$			E_γ: reported in 1975Ni01. I_γ: from 1968Mo16. Other: 7 (1975Ni01).
		1847.9 *2*	94 *2*	0.0	1/2$^+$	E2		E_γ: others: 1850 *3* (1968Mo16), 1848 (1975Ni01). I_γ: from 1968Mo16. Other: 93 (1975Ni01). Mult.,δ: δ(O/Q)=−0.06 *4* or −2.4 *3* from p$\gamma(\theta)$ in 1968Mo16; O component (E3 or M3) is ruled out by RUL. Other values: −0.09 *16* or −2.0 *15* (1969Ha40).
2539.8	3/2$^+$	2539.7 *5*	100	0.0	1/2$^+$	M1+E2	+0.16 *4*	E_γ: other: 2544 *4* (1968Mo16). Mult.,δ: δ(Q/D)=+0.16 *4* or −2.6 *3* from p$\gamma(\theta)$ in 1968Mo16; the larger δ value and E1+M2 are ruled out by RUL based on measured $T_{1/2}$<7 fs.
3491.84	3/2,5/2	1646	60 *15*	1847.96	5/2$^+$			E_γ,I_γ: from 1969Ha40.
		2061	40 *15*	1431.83	3/2$^+$	D+Q		E_γ,I_γ: from 1969Ha40. Mult.,δ: −1.3 *3* if J=3/2, −0.14 *10* if J=5/2, from p$\gamma(\theta)$ in 1969Ha40.
3628	7/2$^+$	1780	30 *20*	1847.96	5/2$^+$	M1+E2	−0.21 *10*	E_γ: from level-energy difference. I_γ: from 1969Ha40. Mult.,δ: D+Q from p$\gamma(\theta)$ in 1969Ha40; E1+M2 ruled out by RUL.
		2196	70 *20*	1431.83	3/2$^+$	E2(+M3)	0.0 *1*	E_γ: from difference of level-energies in 1973Ca20. I_γ: from 1969Ha40. Mult.,δ: Q+O from p$\gamma(\theta)$ in 1969Ha40; M2+E3 ruled out by RUL.
4226.55	7/2$^-$	734.7 *2*	11 *2*	3491.84	3/2,5/2			
		2378.5 *2*	89 *2*	1847.96	5/2$^+$			
5453.17	9/2$^-$	1226.6 *2*	100	4226.55	7/2$^-$	M1+E2	+0.9 *1*	A_2=+0.79 *2*; A_4=+0.23 *2*; pol=−0.72 *14* (1975Ni01) Mult.,δ: from p$\gamma(\theta)$ and γ(lin pol) in 1975Ni01.
5638.58	11/2$^-$	185.4 *6*	46 *2*	5453.17	9/2$^-$	[M1]		
		1412.0 *2*	54 *2*	4226.55	7/2$^-$	E2		A_2=+0.44 *3*; A_4=−0.13 *3*; pol=+0.79 *20* (1975Ni01) Mult.: from p$\gamma(\theta)$ and γ(lin pol) in 1975Ni01.

† From 1973Ca20 for Eγ and 1968Mo16 for Iγ up to 3628 level and from 1975Ni01 above that, unless otherwise noted. 1973Ca20 and 1968Mo16 did not list the γ-ray energies which had been used to deduce the excitation energies in the paper. The evaluators deduced γ-ray energies of transitions to g.s. from the given level energies.

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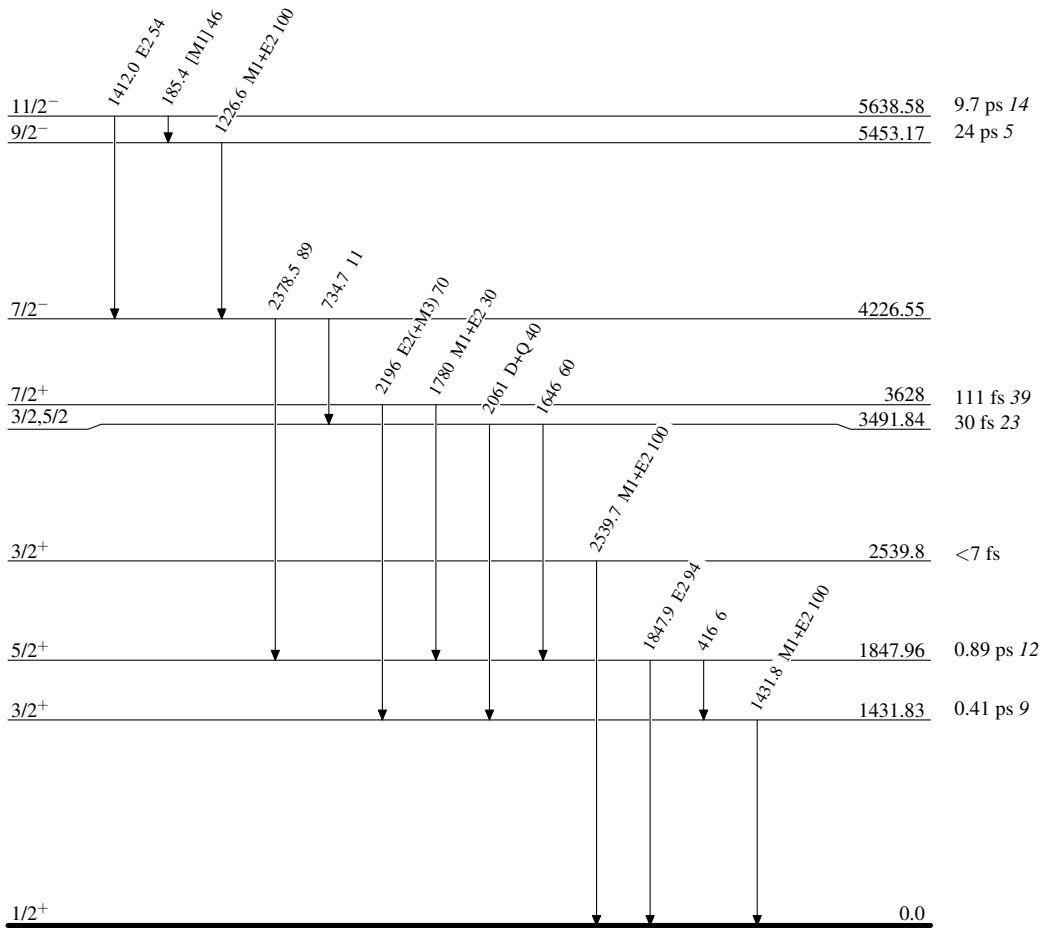
Level Scheme

Intensities: % photon branching from each level



$^{33}_{15}P_{18}$