^{27}Al(^{12}C,αpnγ) 2014Bi16

History

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

2014Bi16: E=40 MeV ^{12}C beam was produced from the 14-UD Pelletron accelerator at Tata Institute of Fundamental Research (TIFR), Mumbai. Target was 0.50 mg/cm^2 ^{27}Al backed by 10 mg/cm^2 thick gold foil to stop the recoils. γ rays were detected with the INGA array of 15 Compton-suppressed Clover Ge detectors placed at 40°, 65°, 90°, 115°, 140° and 157° relative to the beam direction. Measured Eγ, Iγ, $\gamma\gamma$-coin, $\gamma\gamma(\theta)$(DCO), $\gamma\gamma(\theta$,lin pol), Doppler-shift attenuation. Deduced levels, J, π, configurations, γ-ray multipolarities. Comparisons with large-scale shell-model calculations.

^{33}S Levels

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$[#]	Comments
0.0	3/2$^+$		
841.0 *8*	1/2$^+$		
1968.1 *7*	5/2$^+$		
2312.1 *13*	3/2$^+$		
2936.1[@] *7*	7/2$^-$		
2970.1 *8*	7/2$^+$		
3539.1 *12*			
3781.1 *12*	(5/2$^+$)		
4050.1 *8*	9/2$^+$	<0.26 ps	T$_{1/2}$: from mean lifetime τ<0.38 ps.
4095.1 *12*	7/2$^+$		
4730.2 *9*	9/2$^-$	132 fs *28*	T$_{1/2}$: from mean lifetime τ=0.19 ps *4*.
4796.1 *16*	(7/2$^+$)		
4867.2[@] *11*	11/2$^-$	208 fs *35*	T$_{1/2}$: from mean lifetime τ=0.30 ps *5*.
7180.3 *11*	11/2$^+$	<55 fs	J$^\pi$: 13/2$^-$ in Adopted Levels. T$_{1/2}$: from mean lifetime τ<0.08 ps.
7819.3[@] *15*	15/2$^-$	<14 fs	T$_{1/2}$: from mean lifetime τ<0.02 ps.

[†] From a least-squares fit to γ-ray energies, assuming ΔEγ=1 keV.
[‡] As proposed by 2014Bi16 based on earlier assignments and present $\gamma\gamma(\theta)$(DCO) and $\gamma\gamma$(lin pol) data.
[#] From DSAM in 2014Bi16.
[@] Band(A): Band-like structure based on 7/2$^-$.

γ(^{33}S)

DCO(D) is for gate on ΔJ=1, dipole and DCO(Q) for gate on ΔJ=2, quadrupole transition. Typical values are DCO(D)≈1.0 for dipole and ≈2.0 for quadrupole transitions; DCO(Q)≈0.5 and ≈1.0 for dipole and quadrupole transitions, respectively.
For polarization asymmetry (POL) under comments, a positive value indicates electric nature and a negative value indicates magnetic nature.

E$_\gamma$[†]	I$_\gamma$[†]	E$_i$(level)	J$_i^\pi$	E$_f$	J$_f^\pi$	Mult.[‡]	δ[#]	Comments
603		3539.1		2936.1	7/2$^-$			
841	>3.2	841.0	1/2$^+$	0.0	3/2$^+$			DCO(Q)=1.2 *3*; pol=−0.13 *3*
845	5.0 *2*	3781.1	(5/2$^+$)	2936.1	7/2$^-$	(E1(+M2))	+0.1 *5*	DCO(D)=1.0 *2*; pol=+0.02 *1*
968	45.2 *3*	2936.1	7/2$^-$	1968.1	5/2$^+$	E1(+M2)	+0.02 *4*	DCO(Q)=0.52 *1*; pol=+0.05 *2*
1015	0.8 *3*	4796.1	(7/2$^+$)	3781.1	(5/2$^+$)	M1(+E2)	+0.1 *2*	DCO(D)=1.1 *4*; pol=−0.04 *3*
1080	1.4 *1*	4050.1	9/2$^+$	2970.1	7/2$^+$	M1+E2	−0.09 *2*	DCO(Q)=0.35 *3*; pol=−0.02 *1* I$_\gamma$: estimated from branching ratios in Adopted Gammas.
1114	1.7 *2*	4050.1	9/2$^+$	2936.1	7/2$^-$			pol=+0.04 *1*

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γ(^{33}S) (continued)

E_γ[†]	I_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	δ[#]	Comments
1127	0.7 *2*	1968.1	$5/2^+$	841.0	$1/2^+$			DCO(D)=1.5 *3* I_γ: estimated by 2014Bi16 from measured branching ratio, Iγ(1127)/Iγ(1968)=0.7 *2*/99.3 *3*.
1471	2.5 *2*	2312.1	$3/2^+$	841.0	$1/2^+$			DCO(D)=1.06 *9*; pol=−0.04 *1*
1760	4.2 *1*	4730.2	$9/2^-$	2970.1	$7/2^+$	E1+M2	+0.05 *2*	DCO(Q)=0.47 *2*; pol=+0.05 *1*
1794		4730.2	$9/2^-$	2936.1	$7/2^-$			I_γ: very weak transition, Iγ could not be measured.
1931	32.6 *6*	4867.2	$11/2^-$	2936.1	$7/2^-$	E2		DCO(D)=1.9 *1*; pol=+0.05 *1*
1968	100 *2*	1968.1	$5/2^+$	0.0	$3/2^+$	M1+E2	−1.41 *4*	DCO(D)=0.59 *1*; pol=−0.004 *1*
2082	12.2 *3*	4050.1	$9/2^+$	1968.1	$5/2^+$	E2		DCO(D)=2.1 *2*; pol=+0.04 *1*
2127	1.8 *1*	4095.1	$7/2^+$	1968.1	$5/2^+$	D+Q	+0.3 *1*	DCO(D)=3.7 *9*
2312[@]		2312.1	$3/2^+$	0.0	$3/2^+$			E_γ: this γ ray could not be confirmed and distinguished from 2313 line from 7180 level.
2313	2.1 *3*	7180.3	$11/2^+$	4867.2	$11/2^-$	D(+Q)	−0.03 *3*	DCO(D)=2.05 *8*; pol=+0.01 *1*
2450	0.4 *2*	7180.3	$11/2^+$	4730.2	$9/2^-$	D+Q	+0.07 *5*	DCO(D)=1.1 *2* Mult.: E2, ΔJ=2 in Adopted Gammas.
2936	22.6 *7*	2936.1	$7/2^-$	0.0	$3/2^+$	M2+E3	−0.11 *9*	DCO(Q)=1.10 *8*; pol=−0.04 *1* I_γ: estimated by 2014Bi16 from measured branching ratio, Iγ(2936)/Iγ(968)=33 *1*/67 *1*.
2952	6.8 *5*	7819.3	$15/2^-$	4867.2	$11/2^-$	E2		DCO(D)=1.9 *1*; pol=+0.014 *2*
2970	7.5 *3*	2970.1	$7/2^+$	0.0	$3/2^+$	E2		DCO(D)=1.72 *8*; pol=+0.04 *1*

[†] From 2014Bi16.
[‡] Assigned by evaluators, based on $\gamma\gamma(\theta)$(DCO) and $\gamma\gamma$(lin pol) data in 2014Bi16.
[#] From 2014Bi16 based on $\gamma\gamma(\theta)$(DCO) and $\gamma\gamma$(lin pol) data.
[@] Placement of transition in the level scheme is uncertain.

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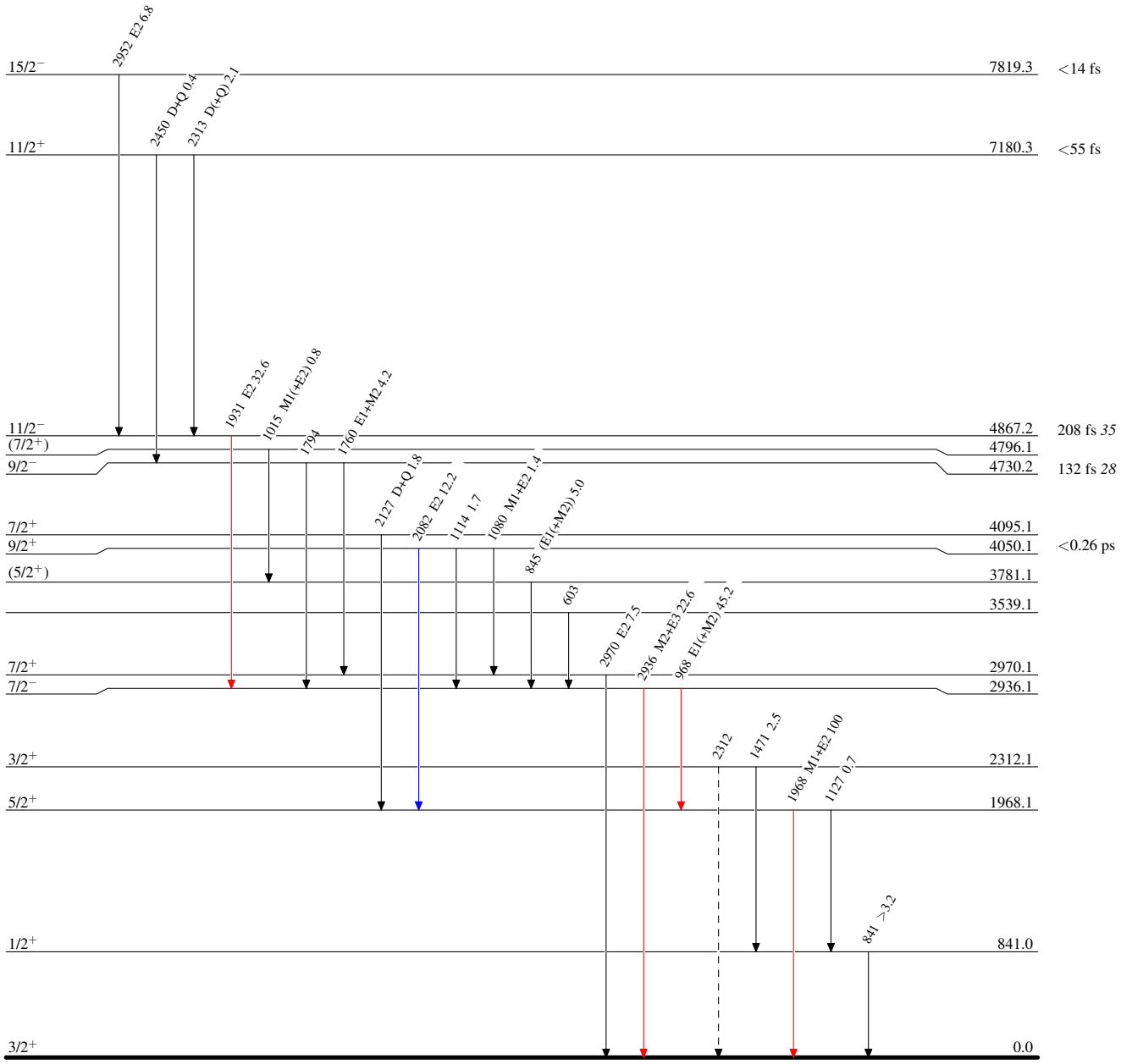
Level Scheme

Intensities: Relative I_γ

Legend
- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- γ Decay (Uncertain)



$^{33}_{16}S_{17}$

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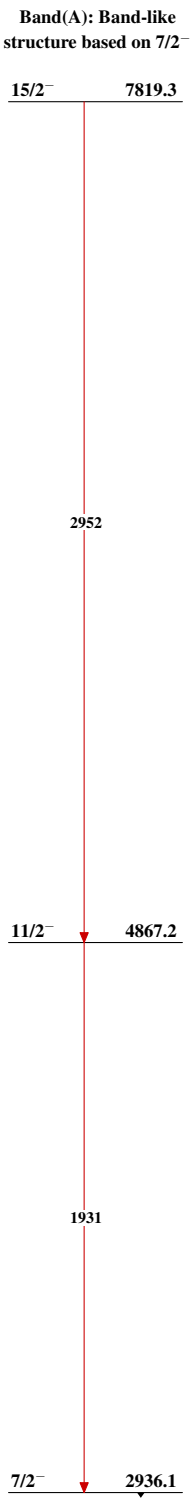

$^{33}_{16}S_{17}$