^{9}Be(^{34}Si,xγ) 2022Ki08,2021El06

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

2022Ki08 (also 2021Ki09): E=94.8 MeV/nucleon ^{34}Si secondary beam was produced via fragmentation of a 140 MeV/nucleon ^{48}Ca primary beam from the Coupled Cyclotron Facility at NSCL on a 846 mg/cm^2 ^{9}Be production target. Fragments were separated with the A1900 fragment separator. The secondary target was 375 mg/cm^2 ^{9}Be. Outgoing particles were momentum-analyzed with the S800 magnetic spectrograph and detected with the focal-plane detectors; γ rays were detected with the GRETINA array consisting of 7 modules, with each module housing 4 crystals and each crystal having 36 segments. Measured Eγ, Iγ, $\gamma\gamma$-coin, γ-ray yields, momentum distributions. Deduced levels, J, π, spectroscopic factors. Comparisons with shell-model calculations.

2021El06: E= 60 MeV/nucleon ^{34}Si secondary beam was produced by fragmentation of a 140 MeV/nucleon ^{48}Ca primary beam on a ^{9}Be target at NSCL. Fragments were separated with the A1900 fragment separator. The reaction target was 52.9 mg/cm^2 ^{9}Be. Reaction residues were analyzed with the S800 spectrograph. γ rays were detected with the GRETINA array of modules each consisting of four segmented HPGe detectors. Measured Eγ, Iγ, $\gamma\gamma$-coin, recoil-γ-coin, recoil distances with the TRIPLEX plunger device. Deduced levels, J, π, $T_{1/2}$, transition strengths. Comparisons with theoretical calculations.

2019El09: E=86 MeV/nucleon ^{34}Si secondary beam was produced using a 140 MeV/nucleon ^{48}Ca primary beam from the NSCL Coupled Cyclotron facility on a ^{9}Be production target. The secondary target was 0.57 g/cm^2 ^{9}Be, placed 72 cm upstream of the center of GRETINA. γ rays were detected with the Gamma-Ray Energy Tracking In-beam Nuclear Array (GRETINA) array consisting of 10 HPGe detector modules, with four at 58°, two at 90° and four at 122° relative to beam axis. Reaction products were identified by time-of-flight and energy-loss measurements with the S800 spectrograph. Measured Eγ, Iγ, $\gamma\gamma$-coin, particle-γ coin, σ(Eγ). Deduced levels, isomer $T_{1/2}$, transition strengths. Comparisons with neighboring even-even isotopes.

2003Ba52 (also 2004Bb03): E=67.1 MeV/nucleon ^{34}Si beam was produced by fragmentation of 140 MeV ^{40}Ar primary beam on a ^{9}Be production target. Fragments were separated by the A1900 fragment separator. The reaction target was 375 mg/cm^2 ^{9}Be. Reaction residues were analyzed with the S800 spectrograph and γ rays were detected with the SeGA array of fourteen 32-fold segmented Ge detectors. Measured Eγ, Iγ, $\gamma\gamma$-coin, particle-γ-coin, σ(Eγ), parallel-momentum distributions. Deduced levels, J, π. Comparisons with theoretical calculations.

^{32}Mg Levels

σ_{exp} given under comments are experimental two-proton knockout cross sections from 2022Ki08.

Inclusive cross section σ_{inc}=0.96 mb *8* at E=94.8 MeV/nucleon (2022Ki08), 0.76 mb *10* at E=67.1 MeV/nucleon (2003Ba52).

Unplaced σ_{exp}=0.056 mb *6* (2022Ki08).

E(level)†	J$^\pi$‡	$T_{1/2}$#	Comments
0	0$^+$		σ_{exp}=0.275 mb *30*.
885.0 *10*	2$^+$	13.1 ps *10*	σ_{exp}=0.072 mb *9*.
1050 *5*	0$^+$	17 ns *10*	J$^\pi$: from Adopted Levels. $T_{1/2}$: from 10 ns<τ<38 ns given in 2019El09. The lower limit of τ is taken from 2010Wi11, which is estimated from GEANT4 simulations. 2019El09 also deduce a lower limit of 8 ns from distribution of decay positions and 1.5 ns from the correlation between partial cross-section and and lifetime for this 0$^+$ state, which also gives the upper limit τ<38 ns, based on 0.03 mb<σ(0$^+$)<0.10 mb with the upper limit of σ from 2003Ba52. B(E2)↑(2$^+$ to 0$^+$)=0.0048 *+74−20* (2019El09).
2288.1 *22*	(0,2)$^+$		σ_{exp}=0.023 mb *2*.
2322.1 *22*	4$^+$	0.62 ps *15*	σ_{exp}=0.071 mb *7*.
2550.9 *23*	(1$^-$,2$^+$)		σ_{exp}=0.020 mb *3*.
2846.1 *32*	(0,2)$^+$		σ_{exp}=0.077 mb *7*.
2858.7 *27*	(2,3)$^-$		σ_{exp}=0.005 mb *3*.
3037.1 *32*	(2)$^-$		σ_{exp}=0.009 mb *2*.
3124.1 *32*	(3$^-$,4$^+$)		J$^\pi$: proposed in 2021El06 based on γ-decay pattern. σ_{exp}=0.013 mb *3*.
3480 *4*	(2)$^+$		J$^\pi$: (1$^-$,2$^+$) proposed in 2021El06.

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^{9}Be(^{34}Si,xγ) 2022Ki08,2021El06 (continued)

^{32}Mg Levels (continued)

E(level)†	Jπ‡	Comments
		σ_{exp}=0.044 mb *4*.
3555.1 *30*	(3,4)$^-$	σ_{exp}=0.006 mb *1*.
3678 *4*	(2,4)$^+$	σ_{exp}=0.054 mb *5*.
3946 *4*		σ_{exp}=0.009 mb *2*.
4095 *4*	6$^+$	σ_{exp}=0.018 mb *2*.
4152.4 *28*	4$^+$	σ_{exp}=0.084 mb *6*.
4707 *5*	4$^+$	σ_{exp}=0.063 mb *6*.
4819 *8*	(2,3)$^-$	
4920 *4*	(2,4)$^+$	Jπ: (0,2,4)$^+$ proposed in 2022Ki08; 1796γ to (3$^-$,4$^+$) disfavors 0$^+$.
		σ_{exp}=0.023 mb *2*.
5233 *5*	4$^+$	σ_{exp}=0.091 mb *8*.
		Jπ: (2$^+$,3$^-$) proposed in 2021El06.

† From a least-squares fit to γ-ray energies.

‡ Proposed in 2022Ki08 based on measured momentum distributions and shell-model predictions, unless otherwise noted. When considered in Adopted Levels, assignments will be placed inside parentheses if there are no strong supporting arguments from other studies.

From 2021El06 using recoil distance Doppler-shift method (RDDS), unless otherwise noted.

γ(^{32}Mg)

Eγ†	Iγ†	Ei(level)	Jiπ	Ef	Jfπ	Mult.	Comments
165 *5*		1050	0$^+$	885.0	2$^+$	[E2]	Eγ: from 165 *+4*(stat)+*2*(syst) (2019El09). A value of 170 *2* is used by 2019El09 for deducing B(E2)↑ and it is weighted average of their value and 172 *2* from 2010Wi11.
x524 *1*	0.9 *1*						
885	100 *3*	885.0	2$^+$	0	0$^+$		Eγ: rounded value from Adopted Gammas. Values from this study: 885 *20* (2003Ba52), 885 (2019El09). Iγ: other: 68 *7* relative to observed fragments (2003Ba52).
1233 *2*	0.8 *2*	3555.1	(3,4)$^-$	2322.1	4$^+$		
1293# *3*	1.1 *2*	4152.4	4$^+$	2858.7	(2,3)$^-$		
1403 *2*	3.5 *2*	2288.1	(0,2)$^+$	885.0	2$^+$		
1437 *2*	38.4 *12*	2322.1	4$^+$	885.0	2$^+$	[E2]	Eγ: other: 1430 *20* (2003Ba52). Iγ: others: 31 *5* (2021El06); 32 *10* relative to observed fragments (2003Ba52).
1602# *4*	0.8 *2*	4152.4	4$^+$	2550.9	(1$^-$,2$^+$)		
1624 *3*	1.3 *2*	3946		2322.1	4$^+$		
1666 *3*	1.9 *2*	2550.9	(1$^-$,2$^+$)	885.0	2$^+$		
1773 *3*	2.7 *2*	4095	6$^+$	2322.1	4$^+$		
1796 *3*	3.4 *2*	4920	(2,4)$^+$	3124.1	(3$^-$,4$^+$)		
x1917 *4*	1.8 *2*						
x1958‡ *4*	15‡ *3*						
1961 *3*	11.5 *6*	2846.1	(0,2)$^+$	885.0	2$^+$		
1973 *3*	1.8 *4*	2858.7	(2,3)$^-$	885.0	2$^+$		
2152 *3*	1.4 *2*	3037.1	(2)$^-$	885.0	2$^+$		
2239 *3*	5.3 *3*	3124.1	(3$^-$,4$^+$)	885.0	2$^+$		Eγ: weighted average of 2238 *3* (2022Ki08) and 2241 *4* (2021El06). Iγ: other: 8.3 *18* (2021El06).
x2296 *6*	1.5 *2*						
x2384‡ *4*	10‡ *2*						

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^{9}Be(^{34}Si,xγ) 2022Ki08,2021El06 (continued)

γ(^{32}Mg) (continued)

E_γ [†]	I_γ [†]	E_i(level)	J_i^π	E_f	J_f^π	Comments
2385 *4*	9.4 *4*	4707	4^+	2322.1	4^+	
2551 *4*	1.8 *2*	2550.9	$(1^-,2^+)$	0	0^+	
2595 *4*	6.6 *4*	3480	$(2)^+$	885.0	2^+	E_γ,I_γ: other: 2595 *6* with Iγ=10 *3* (2021El06).
2793 *4*	8.1 *4*	3678	$(2,4)^+$	885.0	2^+	
2911 *4*	13.7 *5*	5233	4^+	2322.1	4^+	E_γ: weighted average of 2908 *4* (2022Ki08) and 2915 *5* (2021El06). I_γ: other: 10 *2* (2021El06).
[x]3261[‡] *12*	7[‡] *2*					
3268 *5*	10.8 *4*	4152.4	4^+	885.0	2^+	
[x]3415 *7*	0.7 *2*					
3934 *8*		4819	$(2,3)^-$	885.0	2^+	
[x]3961 *7*	1.9 *2*					
[x]4304 *20*	0.5 *2*					
[x]4364 *13*	1.0 *2*					

[†] From 2022Ki08, unless otherwise noted. Intensities are relative to Iγ(885γ)=100. A 3% systematic uncertainty from efficiency calibration as stated in 2022Ki08 has been added in quadrature by the evaluator for intensities from 2022Ki08.

[‡] From 2021El06. Unplaced transitions are in coincidence with the 885-keV transition. However, as they could populate a higher-lying state which decays to the first 2^+ state, they are not assigned a position in the level scheme (2021El06).

[#] Placement of transition in the level scheme is uncertain.

[x] γ ray not placed in level scheme.

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Level Scheme

Intensities: Relative I_γ

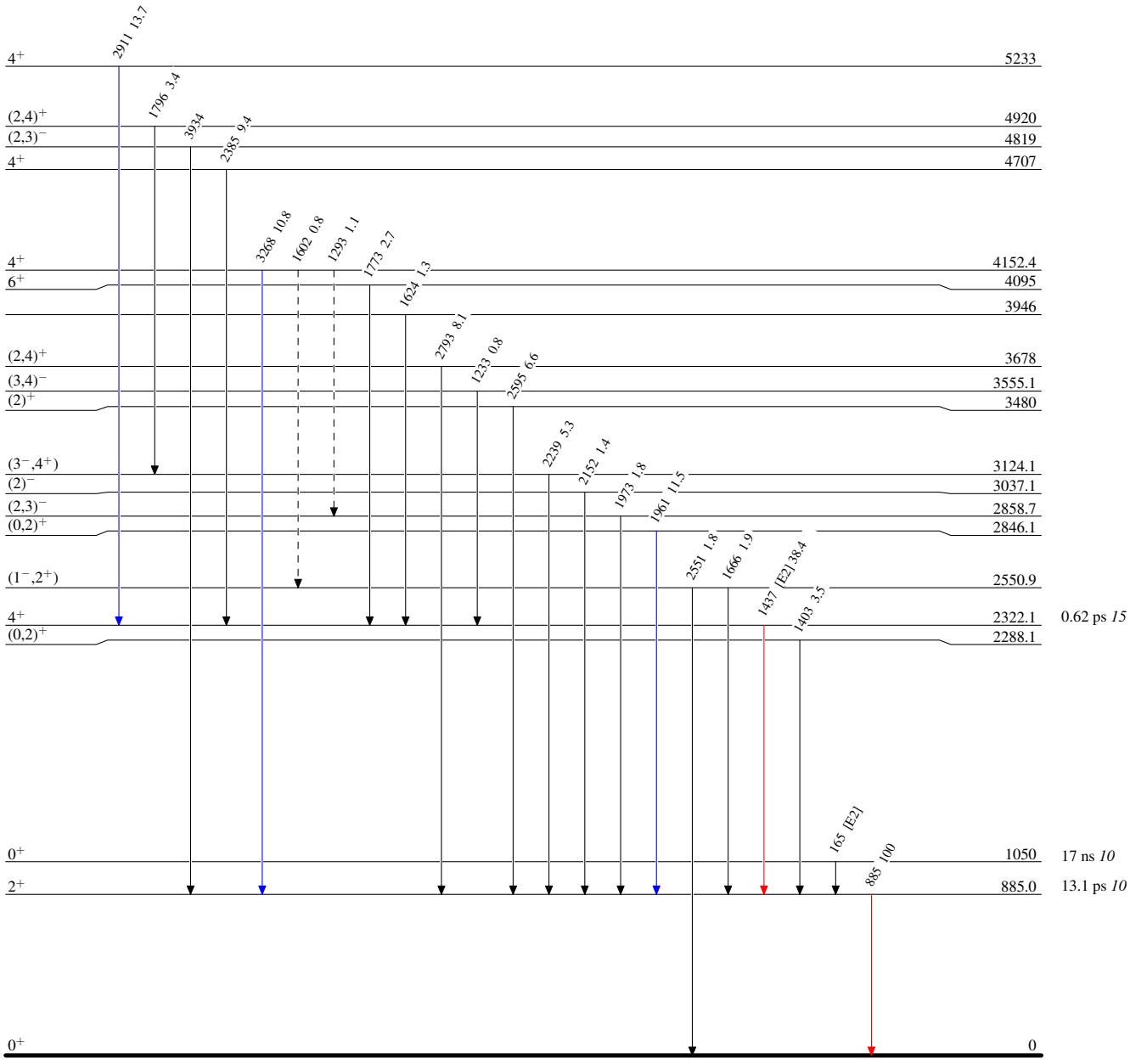
Legend

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

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

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

γ Decay (Uncertain)



$^{32}_{12}Mg_{20}$