^{40}Ca(^{29}Si,αpnγ) 1991Ba20

Type	Author	History Citation	Literature Cutoff Date
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1991Ba20: E=70-95 MeV ^{29}Si beams were produced from the University of Pennsylvania tandem Van de Graaff accelerator. Target was 500 μg/cm^2 isotopically enriched ^{40}Ca on a 32 mg/cm^2 Au backing. γ rays were detected with four Ge detectors, charged particles were detected an 4π array of phoswich detectors and neutrons were detected with a modular system of six neutron detectors filled with liquid scintillator. Measured Eγ, Iγ, particle-γ-coin(t), nγ-coin, n$\gamma\gamma$-coin, n$\gamma(\theta)$, $\gamma\gamma(\theta)$(DCO). Deduced levels, J, π, γ-ray multipolarities, mixing ratios. Systematics of neighboring nuclides.

Additional information 1.

All data are from 1991Ba20 except as noted.

^{63}Ga Levels

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$[#]	Comments
0.0	(3/2$^-$)		
75.39 *28*	(5/2$^-$)	≈25 ns	
1152.59 *37*	(9/2$^-$)		
1422.05 *41*	(7/2$^-$)		E(level): The order of 1422.0γ-624.6γ from a 2047 level in 1991Ba20 is reversed in 2001We11, thus making a level at E=1422 instead, which is confirmed in a more detailed $\gamma\gamma$-coin measurement by 2021Ru07 in (^{28}Si,αpγ).
2046.68 *42*	(9/2$^+$)	<2 ns	
2940.8 *5*	(13/2$^+$)		
4080.2 *6*	(17/2$^+$)		
5853.0 *7*	(19/2)		E(level): From reversing of the order of 1772.8γ-649.1γ cascade from 6502 level in 1991Ba20 who originally propose an intermediate level at 4729 level. See comment at 1772.8γ from 5853 level. J$^\pi$: assigned by the evaluator based on 1772.8γ D, ΔJ=1 to (17/2$^+$).
6502.1 *7*	(19/2,23/2)		
7710.9 *9*			

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

[‡] From 1991Ba20 deduced based on measured n$\gamma(\theta)$, $\gamma\gamma$(DCO), assumption about fusion-evaporation feeding predominantly yrast states and comparison with systematics of neighboring nuclei, unless otherwise noted.

[#] From particle-γ(t) in 1991Ba20.

γ(^{63}Ga)

For DCO values under comments, expected values are ≈0.6 for a stretched quadrupole transition when gating on a dipole transition, ≈2.0 for a dipole transition and ≈1.0 for a stretched quadrupole or a ΔJ=0 transition when gating on a quadrupole transition (1991Ba20).

E$_\gamma$[†]	I$_\gamma$[†]	E$_i$(level)	J$_i^\pi$	E$_f$	J$_f^\pi$	Mult.[‡]	δ	Comments
75.4 *3*	110 *10*	75.39	(5/2$^-$)	0.0	(3/2$^-$)	M1+E2	+0.25 *5*	Mult.,δ: D+Q from $\gamma(\theta)$ in 1991Ba20; E1+M2 ruled out by RUL. Nearly isotropic $\gamma(\theta)$ is consistent with a predominantly a dipole transition (1991Ba20). A$_2$=+0.11 *6*, A$_4$=+0.09 *7*.
624.6 *5*	12 *5*	2046.68	(9/2$^+$)	1422.05	(7/2$^-$)			See comment for 1422.6γ from 1422 level about the placement of 624.6γ-1422.6γ cascade. A$_2$=+0.18 *12*, A$_4$=+0.13 *16*.

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^{40}Ca(^{29}Si,αpnγ) 1991Ba20 (continued)

$\gamma(^{63}Ga)$ (continued)

E_γ[†]	I_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	Comments
649.1 *3*	60 *5*	6502.1	(19/2,23/2)	5853.0	(19/2)		Placed from a level at a 4729 level in 1991Ba20, but not confirmed in other studies. See comment for 1772.8γ from 5853 level about the placement of 649.1γ-1772.8γ cascade. A_2=+0.21 *11*, A_4=−0.21 *15*. DCO=0.9 *3* gate on 1139.4γ (ΔJ=2), consistent with ΔJ=2 or 0. DCO=0.9 *1* gate on 894.1γ (doublet of ΔJ=0 and ΔJ=2), consistent with ΔJ=2 or 0.
894.1[#] *3*	142[#] *6*	2046.68	(9/2$^+$)	1152.59	(9/2$^-$)		A_2=+0.28 *6*, A_4=−0.14 *7*. DCO=0.6 *2* gate on 75.4γ (ΔJ=1), consistent with ΔJ=2; this is likely for 894.1γ from 2941 level. DCO=1.0 *1* gate on 1077.2γ (ΔJ=2), consistent with ΔJ=2 or 0.
894.1[#] *3*	142[#] *6*	2940.8	(13/2$^+$)	2046.68	(9/2$^+$)		DCO=0.6 *2* gate on 75.4γ (ΔJ=1), consistent with ΔJ=2. DCO=1.0 *1* gate on 1077.2γ (ΔJ=2), consistent with ΔJ=2 or 0.
1077.2 *3*	100 *5*	1152.59	(9/2$^-$)	75.39	(5/2$^-$)	Q	A_2=+0.26 *7*, A_4=−0.11 *10*. DCO=0.6 *2* gate on 75.4γ with ΔJ=1, consistent with ΔJ=2.
1139.4 *3*	67 *4*	4080.2	(17/2$^+$)	2940.8	(13/2$^+$)	Q	A_2=+0.34 *9*, A_4=−0.21 *14*. DCO=1.3 *3* gate on 1077.2γ (ΔJ=2), consistent with ΔJ=2. DCO=1.0 *1* gate on 894.1γ (doublet of ΔJ=0 and ΔJ=2), consistent with ΔJ=2 or 0.
1208.8 *5*	23 *8*	7710.9		6502.1	(19/2,23/2)		A_2=+0.32 *30*, A_4=−0.12 *4*. DCO=1.8 *4* gate on 649.1γ and 1.6 *4* gate on 1139.4γ, but it is stated in 1991Ba20 that statistics is insufficient for a firm conclusion about multipolarity, but possibly suggests a dipole character. $\gamma(\theta)$ above is consistent with ΔJ=2 or 0.
1422.0 *5*	8 *4*	1422.05	(7/2$^-$)	0.0	(3/2$^-$)		1991Ba20 place a 1422.0γ-624.6γ cascade from the 2047 level to g.s., making a tentative level at E=625 and state that the order of the two transitions are uncertain. The 625 level is not seen in other studies. The order of the two transitions is reversed in 2001We11, thus making a level at E=1422 instead, which is confirmed in a more detailed $\gamma\gamma$-coin measurement by 2021Ru07 in (^{28}Si,αpγ).
1772.8 *3*	55 *5*	5853.0	(19/2)	4080.2	(17/2$^+$)	D	1991Ba20 place a 1772.9γ-649.1γ cascade from 6502 level to feed the 4081 level, making a tentative intermediate level at 4729. The authors state that the proposed order of the two transitions are tentative. The order of two transitions is reversed in 2001We11 and 2021Ru07 with the intermediate level at 5853, which is adopted by the evaluator. A_2=−0.17 *9*, A_4=−0.21 *13*.

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^{40}Ca(^{29}Si,αpnγ) 1991Ba20 (continued)

$\gamma(^{63}Ga)$ (continued)

E_γ [†]	E_i(level)	Comments
		DCO=2.3 *3* gate on 1139.4γ (ΔJ=2), consistent with ΔJ=1. DCO=1.9 *3* gate on 894.1γ (doublet of ΔJ=0 and ΔJ=2), consistent with ΔJ=1. DCO=3.3 *3* gate on 649.1γ (ΔJ=2 or 0), consistent with ΔJ=1.

[†] From 1991Ba20, unless otherwise noted.
[‡] From 1991Ba20 based on measured n$\gamma(\theta)$ and DCO ratios as given under comments, unless otherwise noted.
[#] Multiply placed with undivided intensity.

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