

⁵⁸Ni(α ,n γ) 1982Sm01,1984Th07,1989Sc28

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	Kazimierz Zuber, Balraj Singh		NDS 125, 1 (2015)	25-Jan-2015

1982Sm01: ⁵⁸Ni(α ,n γ), E=10.75-16 MeV. Measured E γ , $\gamma\gamma$ coin, $\gamma(\theta)$, and γ -ray linear polarization in coin with neutrons detected near 0°.

1984Th07: ⁵⁸Ni(α ,n γ), E=10.3-14.5 MeV. Measured E γ , I γ , $\gamma\gamma$ coin, $\gamma(\theta)$, n γ coin, and $\gamma\gamma(\theta)$.

1989Sc28: ⁵⁸Ni(α ,n γ), E=11.5, 13.0,15, 20 MeV; ⁵⁸Ni(⁶Li,p2n γ), E=30 MeV; ⁵⁴Fe(¹⁰B,p2n γ), E=45 MeV; ⁴⁰Ca(²⁴Mg,2pn γ), E=65, 80 MeV; measured E γ , I γ , $\gamma\gamma$ coin, n γ coin, n $\gamma\gamma$ coin, $\gamma(\theta)$ $\theta=0^\circ-90^\circ$, $\gamma\gamma(\theta)$, n $\gamma(\theta)$, and DSA.

1978Wo01: ⁵⁸Ni(α ,n γ), E=18MeV, 6 γ -rays observed.

The decay scheme is deduced from neutron- γ and $\gamma\gamma$ -coin data (1989Sc28).

From neutron spectrum taken with ³He-filled detector at beam energy of 13 MeV, mass excess of -56.369 8 MeV was derived (1989Sc28).

Additional information 1.

⁶¹Zn Levels

E(level) [†]	J π [‡]	Comments
0	3/2 ⁻	
88.21 10	1/2 ⁻	J π : 1/2 ⁻ (1982Sm01), J=1/2,3/2,5/2 consistent with isotropic $\gamma(\theta)$ (1984Th07), 1/2 ⁻ (1989Sc28).
123.66 9	5/2 ⁻	
418.09 14	3/2 ⁻	
756.05 18	5/2 ⁻	
937.7 3	1/2 ⁻	J π : (1/2,3/2,5/2) (1984Th07). γ -branching ratios in 1984Th07 seem incorrect especially for 519 γ . These are taken from 1982Sm01.
995.96 18	7/2 ⁻	J π : 7/2 ⁻ , stretched E2 996 γ to 3/2 ⁻ (1982Sm01), 7/2 (1984Th07), 7/2 ⁻ (1989Sc28).
1264.67 22	9/2 ⁻	J π : 9/2 ⁻ (1982Sm01), 9/2, however lower spins are not completely excluded (1984Th07), 9/2 ⁻ (1989Sc28).
1362.3 4	3/2 ⁻ ,5/2 ⁻	
1402.2 3	7/2 ⁻	
1657.3 6	5/2 ⁻ ,7/2 ⁻	
2001.7 6	9/2 ⁻	J π : 9/2 ⁽⁺⁾ (1982Sm01), 9/2 ⁻ (1989Sc28).
2098.7 10		
2269.7 9	7/2 ⁻ ,11/2 ⁻	J π : 7/2 ⁻ ,11/2 ⁻ proposed based on 1274 $\gamma(\theta)$ (1989Sc28). 11/2 ⁻ is inconsistent with negative A2 for 1274 γ to 7/2 ⁻ , but 11/2 ⁻ is assigned in Adopted Levels based on E2 multipolarity of 1273.6 γ .
2399.6 7	11/2 ⁻	
2796.7 10	(9/2 ⁻)	J π : 9/2,13/2 ⁻ proposed based on 1532 $\gamma(\theta)$ (1989Sc28). 13/2 ⁻ is inconsistent with negative A2 for 1532 γ to 9/2 ⁻ .
3336.6 12		E(level): Observed only in the heavy-ion reactions (1989Sc28).
4415.6 16		E(level): Observed only in the heavy-ion reactions (1989Sc28).

[†] From least-squares fit to E γ data. $\Delta(E\gamma)$ assumed as 1 keV when not given.

[‡] As proposed by (1989Sc28) based on their n- γ angular distribution measurements, except as noted.

$\gamma(^{61}\text{Zn})$

A₂ and A₄ values are from 1989Sc28, POL values are from 1982Sm01.

All placements of γ rays are from $\gamma\gamma$ coin data.

E _i (level)	J π _i	E γ [†]	I γ [‡]	E _f	J π _f	Mult. ^b	Comments
88.21	1/2 ⁻	88.2 1	100	0	3/2 ⁻	(M1+E2)	A ₂ =-0.07 6; A ₄ =-0.04 8 E γ : average of 88.0 1 (1982Sm01), 88.4 1 (1984Th07).

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⁵⁸Ni($\alpha, n\gamma$) **1982Sm01, 1984Th07, 1989Sc28** (continued)

$\gamma(^{61}\text{Zn})$ (continued)

$E_i(\text{level})$	J_i^π	E_γ^\dagger	I_γ^\ddagger	E_f	J_f^π	Mult. ^b	δ^c	Comments
123.66	5/2 ⁻	123.7 1	100	0	3/2 ⁻	(M1+E2)	-0.05 2	E γ =88.0 1, I γ =4.3 2 (1982Sm01). A ₂ =-0.03 3, A ₄ =-0.07 3 (1982Sm01). E γ =123.6 1, I γ =100 (1982Sm01). δ : other: -0.01 +11-7 or -3.2+17-11 (1982Sm01). A ₂ =-0.13 1, A ₄ =-0.02 1. A ₂ =-0.25 7, A ₄ =-0.05 9 (1982Sm01).
418.09	3/2 ⁻	294.9 4	13 2	123.66	5/2 ⁻	(M1+E2)	-0.44 37	E γ =294.8 3, I γ =2.6 3 (1982Sm01). A ₂ =+0.26 19, A ₄ =+0.20 26.
		329.8 5	20 3	88.21	1/2 ⁻	(M1+E2)	+0.27 13	E γ =330.4 3 1, I γ =6.5 2 (1982Sm01). A ₂ =+0.02 10, A ₄ =+0.12 20. POL=+0.01 20.
		418.5 2	100	0	3/2 ⁻	M1+E2	-0.10 5	E γ =418.4 1, I γ =45.2 9 (1982Sm01). δ : other: +0.04 +27-14 (1982Sm01). A ₂ =+0.15 4, A ₄ =+0.00 5. POL=+0.18 8. A ₂ =+0.24 3, A ₄ =+0.02 4 (1982Sm01).
756.05	5/2 ⁻	338.6 2	100	418.09	3/2 ⁻			E γ =337.0 7, I γ =3.4 1 (1982Sm01).
		631.0 10	5 1	123.66	5/2 ⁻			E γ =632.0 7, I γ =5.7 5 (1982Sm01).
		755.0 3	72 3	0	3/2 ⁻	M1+E2	-0.07 4	E γ =755.6 1, I γ =64.4 12 (1982Sm01). δ : other: -0.3 +1-2 (1982Sm01). A ₂ =-0.66 2, A ₄ =+0.10 2. POL=-0.17 8. A ₂ =-0.75 3, A ₄ =+0.08 4 (1982Sm01).
937.7	1/2 ⁻	519.0 5	16 4	418.09	3/2 ⁻			E γ =520.0 4, I γ =2.6 6 (1982Sm01). I γ : 232 based on data in 1984Th07.
		849.0 10	26.8 24	88.21	1/2 ⁻			E γ =850.2 7, I γ =4.4 4 (1982Sm01). I γ : 49 10 based on data in 1984Th07.
		938.4 5	100.0 ^a 16	0	3/2 ⁻			E γ =938.0 4, I γ =16.4 10 (1982Sm01). POL=+0.8 3.
995.96	7/2 ⁻	578.0 10	<5	418.09	3/2 ⁻			E γ =577.8 3, I γ =3.8 4 (1982Sm01).
		872.2 6	100	123.66	5/2 ⁻	M1+E2	-1.9 1	E γ =872.7 1, I γ =49.0 8 (1982Sm01). δ : other: -1.7 +2-3 (1982Sm01). A ₂ =-0.77 3, A ₄ =-0.24 6. POL=+0.14 9. A ₂ =-0.73 5, A ₄ =-0.14 5 (1982Sm01). E γ : 882 keV in table 1 of 1989Sc28 may be a misprint.
		995.9 2	30 4	0	3/2 ⁻	E2		E γ =996.4 2, I γ =21.8 10 (1982Sm01). δ : other: -0.09 -9+7 (1982Sm01), A ₂ =+0.19 5, A ₄ =-0.49 9. POL=+0.32 27.
1264.67	9/2 ⁻	1141.0 2	100	123.66	5/2 ⁻	E2		A ₂ =+0.31 5, A ₄ =-0.14 5 (1982Sm01). E γ =1141.1 1, I γ =63.9 10 (1982Sm01). δ : other: +0.02 +1-3 (1982Sm01), A ₂ =+0.35 6, A ₄ =-0.28 8. POL=+0.42 14.
1362.3	3/2 ⁻ , 5/2 ⁻	606.0 [@] 5	14 [#] 2	756.05	5/2 ⁻			A ₂ =+0.42 2, A ₄ =+0.15 2 (1982Sm01). E γ =606.0 5, I γ =1.0 1 (1982Sm01). E γ : 406 keV in table 1 of 1989Sc28 may be a misprint.
		944.0 [@] 10	34 [#] 6	418.09	3/2 ⁻			E γ =944.0 10, I γ =2.4 4 (1982Sm01).
		1240 ^{@d}	50 ^{&}	123.66	5/2 ⁻			E γ =1237 keV in 1989Sc28. Questionable placement in 1982Sm01, no intensity is given.
		1362.0 [@] 10	100 [#]	0	3/2 ⁻	(M1+E2)		E γ =1362.0 10, I γ =7.2 4 (1982Sm01). δ : -0.29 17 or +0.18 11 (1989Sc28). A ₂ =-0.02 16, A ₄ =+0.25 20.

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⁵⁸Ni(α ,n γ) **1982Sm01,1984Th07,1989Sc28** (continued)

$\gamma(^{61}\text{Zn})$ (continued)

$E_i(\text{level})$	J_i^π	E_γ^\dagger	I_γ^\ddagger	E_f	J_f^π	Mult. ^b	δ^c	Comments
1402.2	7/2 ⁻	646.8 5	100	756.05	5/2 ⁻	M1		POL=-0.55 6. E γ =646.7 3, I γ =7.1 5 (1982Sm01). Branching ratio=2% (1989Sc18).
		984.0 10	30 8	418.09	3/2 ⁻			E γ =984.4 3, I γ =8.8 7 (1982Sm01). Branching ratio=12% (1989Sc18).
		1279.0 10	16 4	123.66	5/2 ⁻			E γ =1278.6 7, I γ =6.1 6 (1982Sm01). Branching ratio=17% (1989Sc18).
		1401.7 4	32 7	0	3/2 ⁻			γ not reported in 1982Sm01. Branching ratio=69% (1989Sc18).
1657.3	5/2 ⁻ ,7/2 ⁻	1239.0 7	100	418.09	3/2 ⁻			γ not reported in 1982Sm01; a 1240 γ questionable placement shown from 1362 level.
		1534.0 10	38 7	123.66	5/2 ⁻	(M1+E2)	-1.4 9	E γ =1534.0 10, I γ =20.9 21 (1982Sm01). A ₂ =-0.39 13, A ₄ =-0.98 21.
2001.7	9/2 ⁻	1004.7 9	89 24	995.96	7/2 ⁻	M1(+E2)	-0.4 4	E γ =1006.1 2, I γ =17.8 14 (1982Sm01). A ₂ =-0.77 11, A ₄ =+0.13 18. POL=+0.9 3. A ₂ =-0.53 5, A ₄ =+0.05 6 (1982Sm01). Mult.: \$(D+Q)\$ (1982Sm01); δ =-0.1 1.
		1246.3 7	100	756.05	5/2 ⁻	Q		E γ =1247.4 4, I γ =12.9 9 (1982Sm01). A ₂ =+0.33 11, A ₄ =-0.58 16.
2098.7		1975 ^{&}	100 ^{&}	123.66	5/2 ⁻			
2269.7	7/2 ⁻ ,11/2 ⁻	1005 ^{&}	6 ^{&}	1264.67	9/2 ⁻			
		1273.6 18	100	995.96	7/2 ⁻			E γ =1273.7 4, I γ =12.5 5 (1982Sm01). A ₂ =-0.26 10, A ₄ =-0.51 14. POL=+0.4 4. Mult.: $\gamma(\theta)$ data in 1984Th07 suggesting (M1+E2) with δ =+1.9 4 are in conflict with those from 2006An31, the latter assigned E2 based on $\gamma\gamma(\theta)$ (DCO), asymmetry ratios and $\gamma(\text{lin pol})$ data.
2399.6	11/2 ⁻	1403.6 [@] 7	100 [#]	995.96	7/2 ⁻			E γ =1403.6 7, I γ =34.7 15; POL=-0.1 2 (1982Sm01) (this γ may be contaminated by a possible 1403-keV g.s. transition).
2796.7	(9/2 ⁻)	1532 ^{&}	100 ^{&}	1264.67	9/2 ⁻	(M1+E2)	-2 1	A ₂ =-0.26 12, A ₄ =-0.47 18.
3336.6		937 ^{&}	100 ^{&}	2399.6	11/2 ⁻			
4415.6		1079 ^{&}	100 ^{&}	3336.6				

[†] From 1984Th07, except as noted.

[‡] Relative branchings from each level. Values are from 1984Th07, except as noted. For corresponding values available from 1982Sm01 and 1989Sc28, disagreements (for example for 1402 level) are found in many cases.

[#] From $\gamma(\theta)$ in coin with neutrons at E α =15 MeV (1982Sm01).

[@] From 1982Sm01.

[&] From 1989Sc28.

^a From 1982Sm01.

^b From n $\gamma(\theta)$ (1989Sc28,1982Sm01) and pol(θ) data (1982Sm01).

^c From 1989Sc28. Values from 1982Sm01 are listed under comments.

^d Placement of transition in the level scheme is uncertain.

$^{58}\text{Ni}(\alpha, n\gamma)$ 1982Sm01, 1984Th07, 1989Sc28

Legend

Level Scheme

Intensities: Relative photon branching from each level

-----▶ γ Decay (Uncertain)